*Geography for Secondary Schools*

VOLUME III: AFRICA AND THE AMERICAS

*By the same authors (In this series)*

Vol. I. People and Place

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Vol. IV. Australia and Eurasia

Geography for Secondary Schools

VOLUME III

# AFRICA AND THE AMERICAS



by

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# FOREWORD

This book on Africa and the Americas is intended to provide an extension of the basic geographic knowledge and skills introduced by the earlier volumes of the series written for pupils of secondary schools. At the same time it is aimed at giving certain more advanced principles of systematic and regional geography. These will be more fully developed in the following and final textbook, devoted to Eurasia and Australia.

Addressed to senior students, the work is so organised as to promote a progressively deeper understanding of the complex relationships between people and the land in the modern world and more especially in the three continents under consideration. This is achieved by a proper recognition of the relative importance of the physical earth and the economic utilisation of its resources by man in terms of his heritage of traditions, attitudes, objectives and technological skills. It is hoped that such a content will lead to a geographical way of thinking and an awareness of the fact that patterns of land use can only be fully appreciated against a background of historical, social and political trends and problems.

Towards such ends, for example, the studies of African regional climates serve to introduce certain world patterns of climate-vegetation relationships. The biogeographic associations are then extended to studies of African land use, the contrasts between primitive and advanced societies, and the current problems of racial contacts within the population. Points made concerning such contacts are developed still further in the regional work on South America, where there is a significant historical background to its socio-economic aspects, particularly those related to agriculture and minerals. With so much of this continent lying in low latitudes, the opportunity is taken to examine the problems of man in the inter-tropics of the world and the contrasts offered between his way of life there and in the temperate areas. The final chapters on North America serve to illustrate the amazing complexity of modern large-scale agriculture and industry, with the resultant patterns and problems of population, transport and conservation of natural resources. All this is seen against a background of systematic studies in landforms, soils and minerals. Opportunity is taken for constant cross-reference, so that likenesses and differences between the continents, with their relationships in the world of today, are made clear.

The method of approach, therefore, stresses a close relationship between maps and textual material and urges constant reference to supplementary reading and illustration. At the same time the treatment is kept broad and not too technical either in subject matter or in terminology. The material introduces many important modern developments, and the language is kept simple, at the same time making frequent use of terms which should lead to the building up of an extensive geographic vocabulary.

Special attention has been given to the planning and drawing of a wide range of maps and diagrams. The more detailed types can be used as sources of information in themselves apart from the accompanying text and may well be made the basis of class discussions. In many cases they can be simplified by being re-drawn as a related series. The simple line drawings and map-summaries are good examples of the way in which pupils themselves can use sketches effectively to supplement and visualise their geographic information. The maps are not intended to supplant a good atlas, to which constant reference should be made for many details.

Exercises are included throughout the book so as to enable students both to consolidate their knowledge of facts and principles and to learn to study geographic problems from a variety of viewpoints. Suggested activities to develop skills include studies designed to develop independent and individual powers of geographic description, discussion and analysis. Comparisons and contrasts of continents and regions, people and place are also intended to encourage a wider use of both group discussions and the reference library. In particular, an effort has been made to pose problems that are likely to be current and have even a personal interest for students. Their acquaintance with those geographic realities with which they will normally deal can be achieved to a degree by excursions, local surveys, visits, interviews and reference to periodicals, newspapers and radio programmes. Finally each group of exercises usually gives some opportunities for map interpretation, map-making and the revision of the geographic vocabulary. An appendix on methods of drawing sketches will be found useful.

Altogether, this book is not intended to be exhaustive but rather to stimulate those wider studies and interesting lines of thought which are made possible by that greater freedom in the planning and selection of material which is characteristic of the spirit of the modern geography syllabus.

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# SECTION I: AFRICA

## CHAPTER I

## PHYSICAL FEATURES

### Position and Size

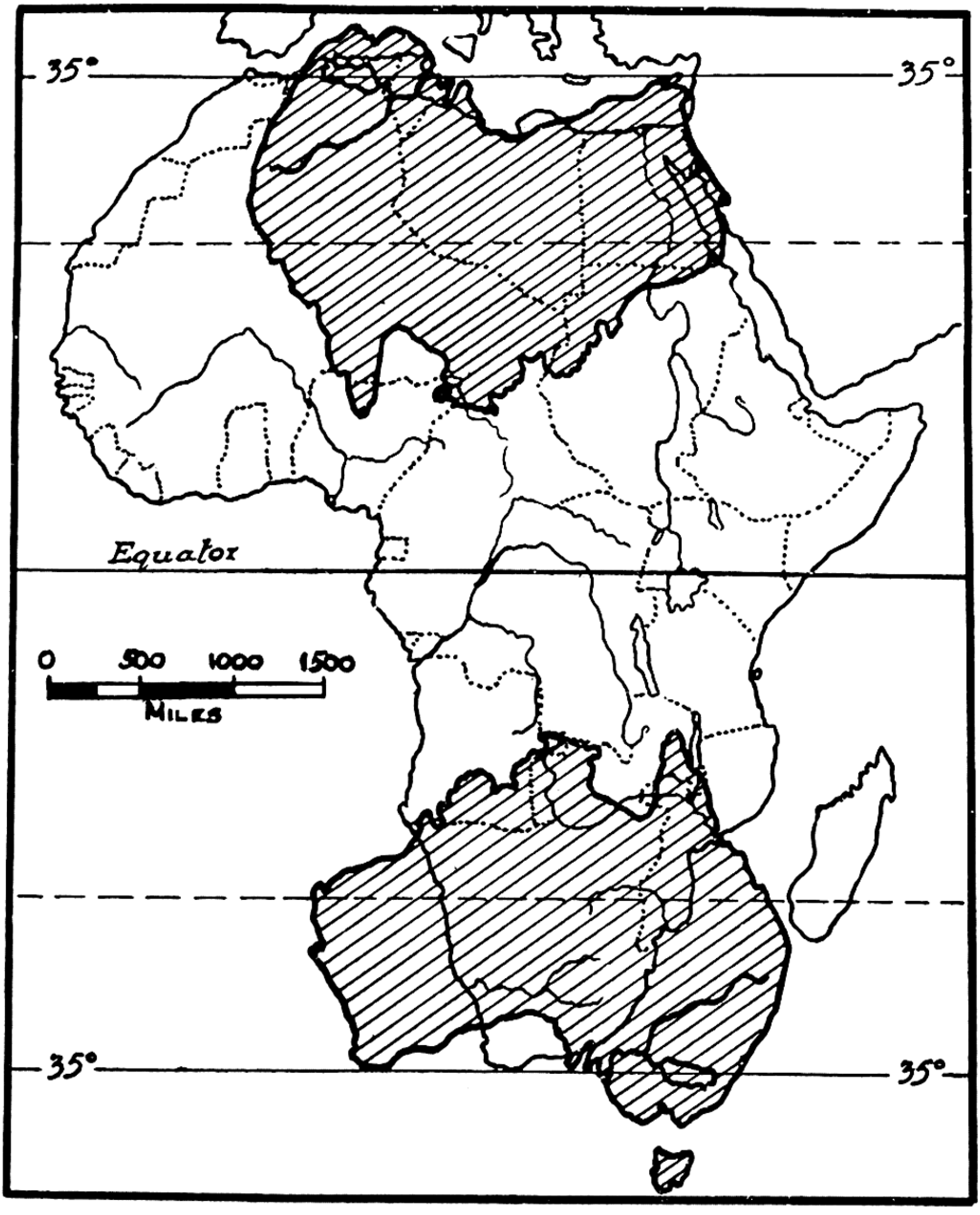


FIG. 1. *Position and size of Africa. Australia is inset correct to scale and in its correct latitudinal position.*

Africa, with an area of 11½ million square miles, is the second largest continent. It is a huge and very compact land mass bisected by the Equator—a fact which has a profound effect on its climate and vegetation. Figure 1 shows that it extends from approximately 35° N. to 35° S. latitude and is several times as large as Australia, which is superimposed in its correct latitudinal position both north and south of the Equator. Because of its shape (like the numeral 9) the greater part of it lies north of the Equator and it is at its widest in latitudes 10° to 12° N.

It lies south of Europe and south-west and west of Asia and in reality is an extension of the great land mass of Eurasia.

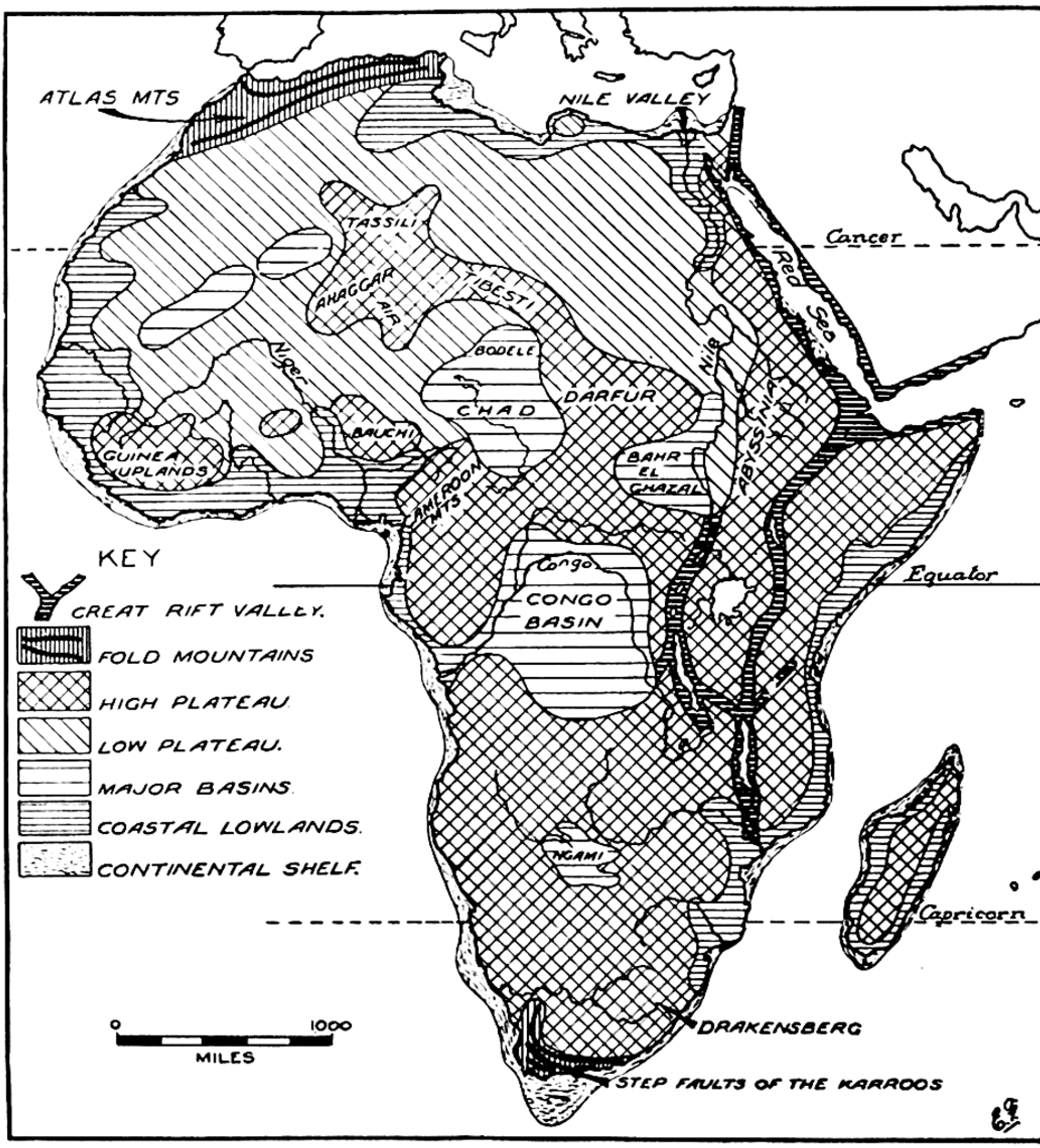


FIG. 2. *Build of Africa.*

## Physical Structure

Figures 2 and 3 show the general physical structure of Africa: Figure 2 is a diagrammatic sketch to help you visualise the landforms and Figure 3 is a simple map of landforms. Like Australia, Africa is a compact continent of the plateau type, but the African plateau is far more significant than the Australian.

The African continent consists of a plateau which extends without interruption from the northern Saharan edge to south of the Orange River in Cape Colony and from the Sierra Leone coast to Somaliland. Broadly it is high plateau south of the Equator and low plateau north


FIG. 3. *Pictorial sketch of the main physical features of Africa.*

of it with flanking fold mountains on the north and south edges (the Atlas and Cape ranges—see Figures 4 and 32).

This great plateau block consists of a rigid mass of ancient rocks that has remained practically unchanged in form for at least 200 million years. It resisted the great earth storms which resulted in the formation of most of the present fold mountain systems during Miocene times (perhaps 15-20 million years ago—see Figure 8). Though undisturbed by the Miocene earth folding it is wrong to regard the present plateau as having been undisturbed through all time. Geological evidence shows that the rocks of the whole plateau area underwent intense folding and considerable fracturing in Pre-Cambrian and early Palaeozoic times. (See Figure 8 for details of all geological ages and eras.) They were subsequently worn down to a common peneplain surface and then uplifted *en masse* to form a much higher plateau than is now present. This, except for isolated outlier remnants, was again worn to a peneplain prior to the Miocene period and again uplifted as a block to form the general surface seen today. Either during this general uplift or shortly afterwards the huge block cracked under the strain of the movement to form the Great Rift Valley down its eastern side.

The present surface, then, is one of an uplifted peneplain on which the forces of erosion have been operating for several million years. The higher parts owe their present eminence to the reduction of the surrounding country by this erosion and to their own greater resistance because of harder rock. Other elevated portions are volcanic in origin.

**1. The High Plateau** rises sharply from narrow coastal plains to an elevation between 3000 and 5000 feet. Its surface is characterised by large expanses of level or gently undulating country. These generally level landscapes may occur at different heights over the plateau, as there are different periods of uplift and erosion represented by them. One well-marked level occurs at 7000 to 8000 feet in several parts of South Africa where it now stands out as flat-topped ridges. A more important one, very common throughout southern Africa and extending northwards besides the Red Sea to the Gulf of Suez is at 2500 to 4000 feet. This is the Miocene peneplain mentioned above.

The present surface is cut across by the Great Rift Valley and on its eastern side has been capped by the outpourings of many volcanoes which developed during the uplift and cracking. Enormous areas of lava covered Ethiopia and western Kenya and a number of extinct volcanic cones form the highest mountains in Africa. The most notable among these are Kilimanjaro (19,565 feet), Kenya (17,040 feet), Elgon (14,176 feet), Ras Dashan (15,160 feet) and the Cameroon Mountains in West Africa. Ruwenzori (16,795 feet), north of Lake Tanganyika, is a remnant of a higher plateau area and not a volcano.

Several broad shallow basins on the uplifted Miocene surface gave rise to vast inland seas or lakes, which have since mostly silted up. Lake

Chad, the Central Congo Basin and the Upper Niger Delta are examples of these. Victoria Nyanza, the largest lake in Africa, occupies a huge crustal sag in an old lava flow. Its area of 26,000 square miles is equal to that of Tasmania.

**2. The Low Plateau** stretches north and west from the Congo Basin and has a general elevation of 1000 to 1500 feet. It is occupied mainly by the Sahara, and here the older base rocks are mostly hidden by a mantle of sand and wind-borne deposits. It is crossed through the centre by remnants of older plateaux: e.g., the Darfur, Tibesti, Tasili and Ahaggar uplands, which average over 3000 feet in elevation, and which are capped by volcanic peaks of 10,000 and 11,000 feet in the Tibesti uplands. The low plateau is flanked on the west and south by the volcanic Cameroon Mountains and the Futa Jallon block in French Guinea. Practically all of the Sahara has either inland drainage or no drainage at all.

Africa has very little extensive alluvial or coastal lowland, since the river valleys are largely deep trenches cut in the plateau surface and the edge of the plateau is rarely more than 20 miles from the coastline. Those riverine or coastal lowlands that do occur tend to have an exaggerated significance.

The very regular coastline of Africa is 19,000 miles long, less than that of Europe with but one-third of its area. The plateau scarp often reaches the coastline to form high and forbidding cliffs and along the whole coastline there is a dearth of deep inlets or sheltered bays. Instead there are often stretches of several hundred miles with no harbours at all. Both these factors acted against easy development of the continent and gave special significance to any gaps in the scarp made by rivers: e.g., the Congo, Niger, Senegal and Zambesi.

The absence of coastal plains also means that there are no large areas of continental shelf. The 100-fathom line hugs the coast except in the north-west, the Mediterranean and round Cape Colony. Sea fishing is therefore of little importance outside these places.

**3. Fold Mountains** occur throughout the Barbary States of North Africa and in the Cape of Good Hope in South Africa.

The Atlas fold mountains of the north are a continuation of the great European system of folds which radiate from the Alps. Figure 4 shows first, the pattern of the Atlas folds and secondly, their general relation to the European fold systems through Sicily and southern Spain. Notice that there are really two systems of folds, which enclose the Plateau of Shotts (the Shotts are salt lakes or salt marshes). These folds, and their European companions, were formed during the middle Tertiary period (Miocene) possibly as a result of the great plateau mass of Africa moving northwards and squeezing the intervening rocks against another stable plateau mass in Russia and Scandinavia.

Examination of the section in Figure 4 will show the great difference in earth disturbance between the Tell Atlas and the Saharan Atlas. The

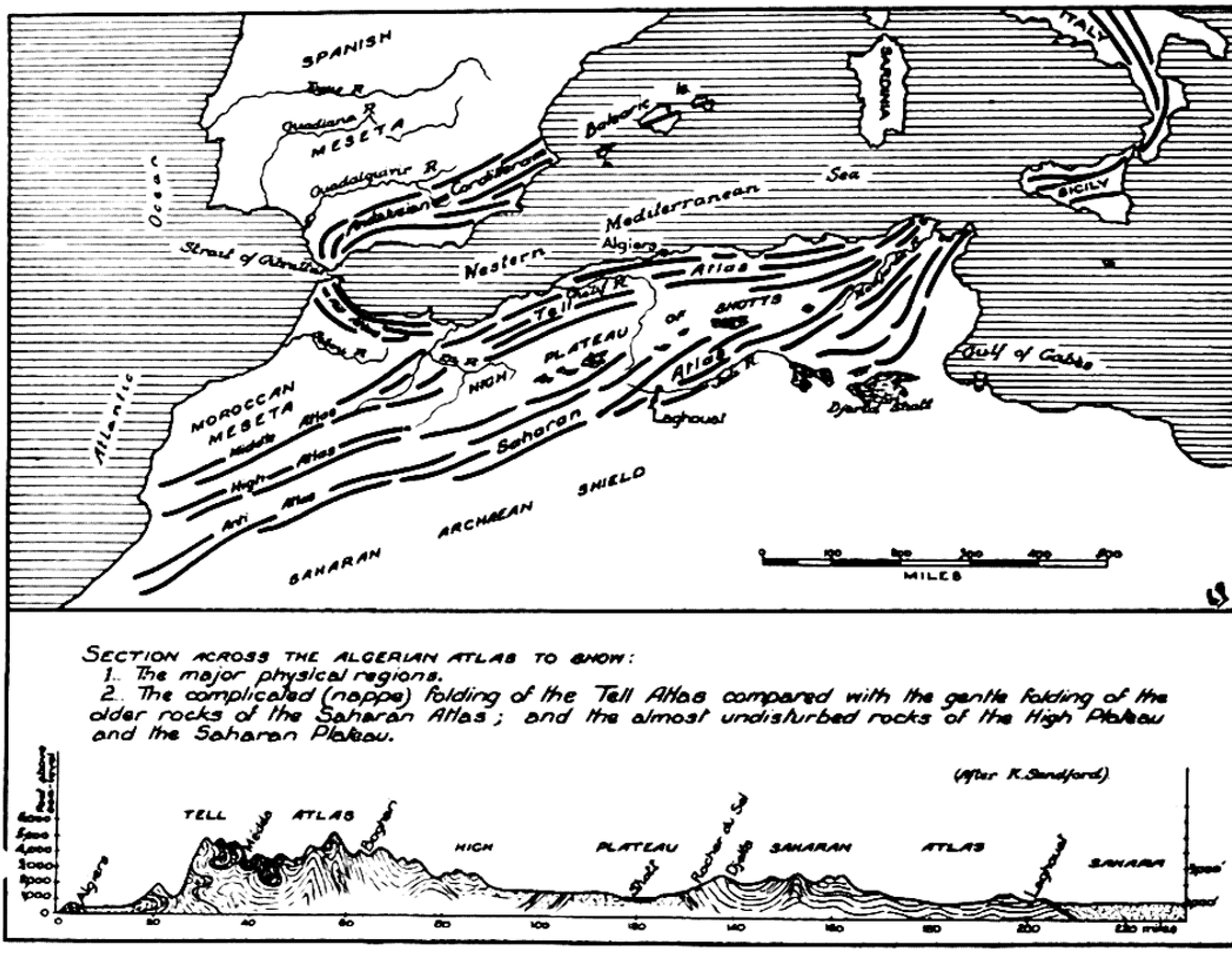


FIG. 4. *General pattern of the folds in the Atlas Mountains and their relation to the European fold mountains.*

Tell Atlas was in the midst of the great earth storm causing the crustal wrinkles, while the Saharan Atlas was farther away and hence less disturbed.

**4. Rift Valleys.** During the late Tertiary and early Quartenary period two events of note occurred: (*i*) the Great Rift Valley was formed; and (*ii*) there was considerable volcanic activity, both associated with the Great Rift Valley and elsewhere along other lines of fracture and weakness.

Rift valleys are found in many parts of the world where faulting and fracturing of older rocks has occurred. In Australia the best examples are the rift valleys occupied by Spencer and St Vincent's Gulfs with the Yorke Peninsula and Mt Lofty-Flinders ranges as horsts adjoining the rifts. The Middle Rhine in Europe runs along the floor of a notable rift valley flanked by the Vosges and Black Forest horsts. Lake Baikal in Siberia occupies another rift and the Lowlands of Scotland yet another.

In all cases the rifts are bounded by a series of step faults rather than by a single scarp. Often their formation is accompanied by the upthrusting of a crustal block to form a horst mountain system (see inset to Figure 5). The horsts usually drop steeply to the valley but slope more gradually away from it.

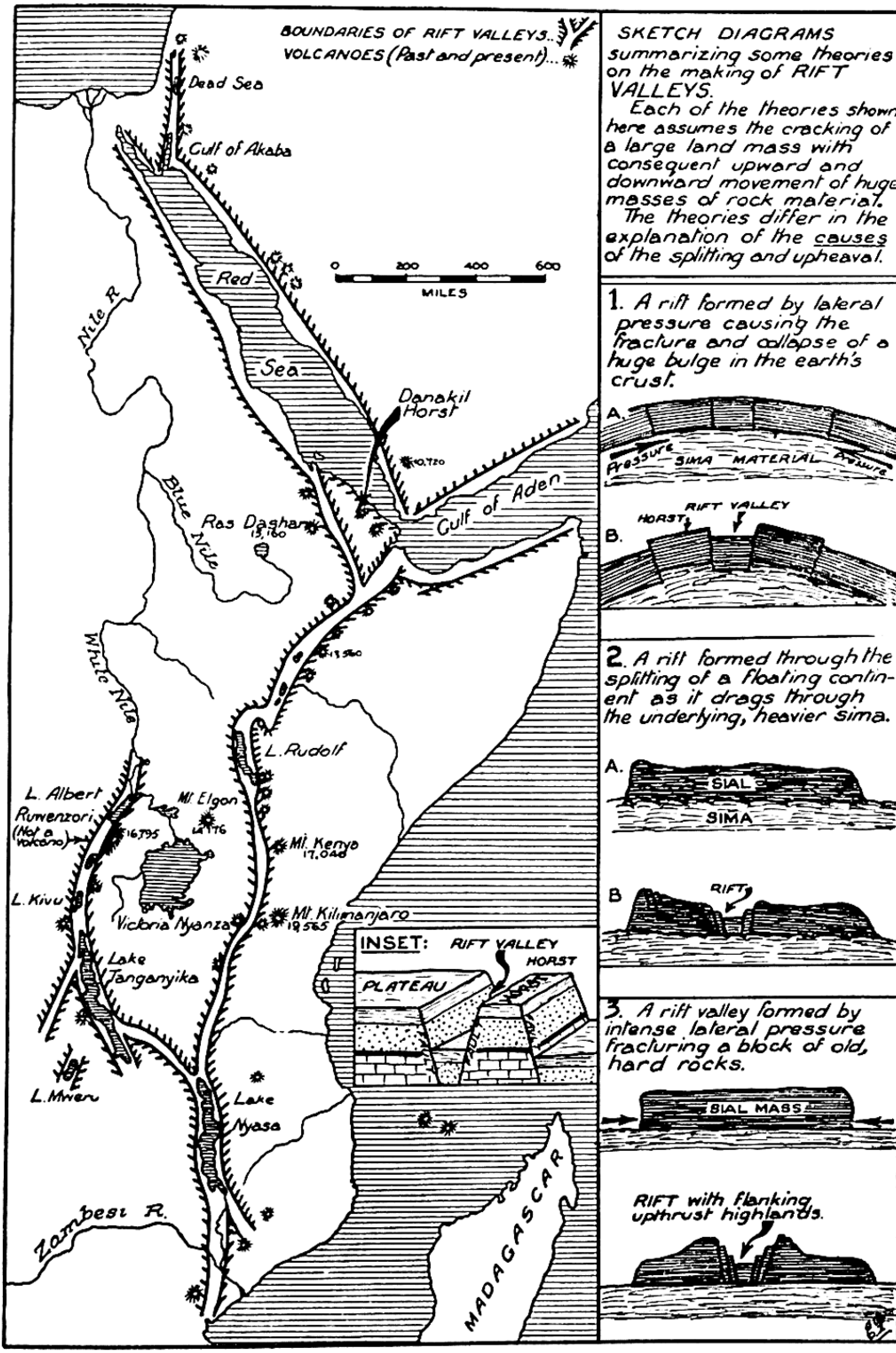


Fig. 5. *Great Rift Valley of Africa, with appended sketches to show some of the theories for the formation of rift valleys.*

The so-called Great Rift Valley of Africa shown in Figure 5 is in reality a series of rifts and horsts more or less joined over a distance of some 5000 miles. In the Red Sea area, in Kenya, and in the Nyasa and Tanganyika lake portions, its features are clearly defined and the scarps bordering it form a striking feature of the local topography. Elsewhere its location is often hard for any but the trained geologist to find. Its width of from 20 to 50 miles is remarkably uniform except in the Red Sea area, where it is from 120 to 200 miles wide. The floors of the valley vary greatly in level from well above sea-level to over 1000 feet below sea-level on the bottom of Lakes Tanganyika and Nyasa. The horsts bordering it vary in elevation from 5000 to 9000 feet along the Red Sea, to 8000 feet alongside Lakes Nyasa and Tanganyika, and to 12,000 feet near Lake Kivu, where the older Ruwenzori massif dominates the area.

Various theories have been advanced for the formation of rift valleys. Some of the older ones are summarised in Figure 5. All of them require fracturing of the earth's crust with a subsequent movement of large portions, both upwards and downwards. It is regarding the causes of the fracturing and movement that geologists disagree. If one accepts the Wegener Hypothesis of Continental Drift, as sketched in No. 2 diagram of Figure 5,

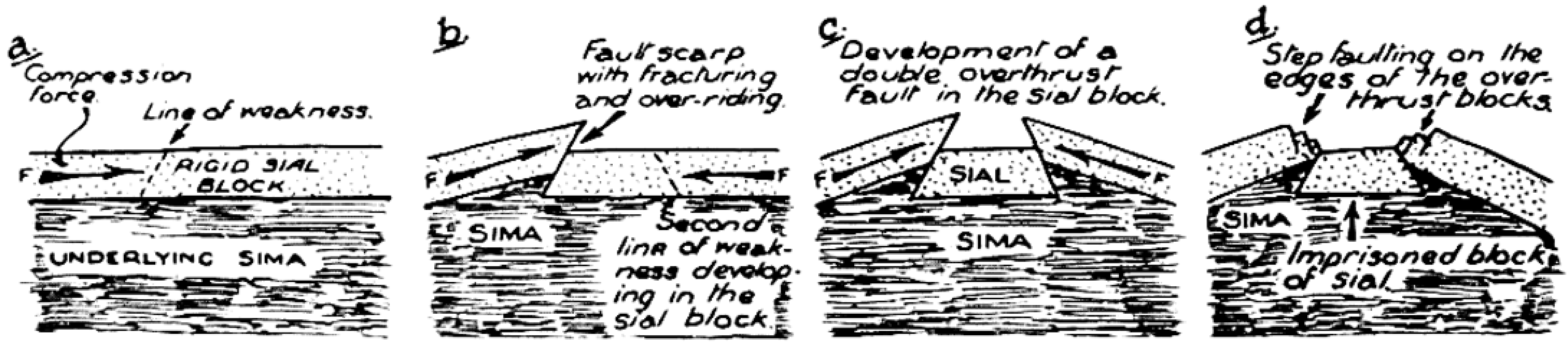


FIG. 6. *Sequence sketch diagram to illustrate the latest theory of the formation of rift valleys.*

then the explanation of rift valleys is easy. But many geologists do not subscribe fully to the Continental Drift theory, and leading astronomers have said recently that it is impossible. The most generally accepted theory today postulates the double fracturing of part of the crust by compression forces. This is followed by the overriding of a block of sial by the two side blocks (sial is the name given to the rocks of the earth's surface and is a contraction of silica and aluminium, their principal constituent elements). The block of sial is trapped and held down by the overthrust horsts on its sides. Step faulting along the edges of the horsts follows because of weaknesses there. This theory is summarised in Figure 6 and is almost directly contrary to the Wegener theory.

**5. Drainage.** Although most of African drainage reaches the sea (i.e., is outward draining or *exoreic*), very large areas in the Sahara and Kalahari regions have inland drainage (i.e., are inward draining or *endoreic*) or no drainage at all (i.e., are *areic*). Five large river systems—the Nile, Niger, Congo, Zambesi and Orange—account for most of the exoreic (outward) drainage. These rivers rise in watersheds and highlands on the top of

the plateau and after meandering in mature and old valleys for part of their upper course they plunge over waterfalls or rapids as they descend to the lower coastal areas. In most instances the descent from the plateau to the lowlands is by a series of falls and rapids rather than by a single fall. Examples may be seen on the Nile with its six cataracts, the Zambesi with Victoria Falls 343 feet high followed by the Molele, Kanzalo and Quebrabasa rapids at intervals farther down the river. These rapids and falls prevent through navigation on any of the African rivers, but they offer possible sources of hydro-electric power should the countries ever need it.

The annual run-off or discharge of the African rivers varies greatly both in the amount discharged by different rivers and in the seasonal flow. Much of Africa has a marked summer rainfall, and this is reflected in the flow of its rivers throughout the year. Thus the Zambesi, with its basin lying entirely within a summer rain area, has an annual flow of approximately 100 million acre feet near its mouth. (The Murray, Australia's largest river, has an annual discharge of 10 million acre feet.) The seasonal flow varies from about 12,000 cusecs at low water in winter to over 250,000 cusecs at the peak of the rainy season. (A cusec is one cubic foot per second and is used in measuring river flow past a point.)

The Congo, with an average annual discharge of approximately 1500 million acre feet, is the second largest river in the world. Its flow is much more regular than that of the Zambesi because much of its basin lies in a region of reasonably uniform annual rainfall.

The Nile, with a discharge of 70 million acre feet a year at Aswan, is the third largest river of Africa. Its flow varies greatly throughout the year owing to the annual summer flooding of the Blue Nile and the Atbara. The discharge above Khartoum is about 25 million acre feet a year. The Blue Nile floods add over 45 million acre feet to this and the Atbara about 11 million. Loss by evaporation and irrigation reduces the total of 81 million acre feet near Berber to the 70 million discharged below Aswan.

Figures for the Niger are not available, but general descriptions of its yearly floods (from the summer rains of its basin) indicate that its discharge would be smaller than that of the Nile. It shows tremendous variations in flow between wet and dry seasons in its upper course; but below Niamey its flow is more regular because of the longer rainy season on the watersheds of its lower course.

**6. Geology.** The very simplified geological map in Figure 7 shows that old rocks of early Palaeozoic or Pre-Cambrian eras occupy over three-quarters of the African continent. They outcrop on the surface over half of this area and elsewhere are buried beneath deposits of more recent material as in the Sahara. This type of rock is most commonly associated with the formation and accumulation of mineral deposits. The African area has numerous large occurrences of mineral ores which are discussed in a later chapter.

The older sedimentary rocks, mostly of the Permian or Carboniferous periods, are found mainly in South Africa, Natal and parts of the Rhodesias and Tanganyika. They are significant because they contain the main coalfields, especially in Transvaal and Natal. The large areas of recent alluviums shown on the map are either in deltas or lake-filled basins along the course of some of the larger rivers. They are of some importance as foci of settlement.

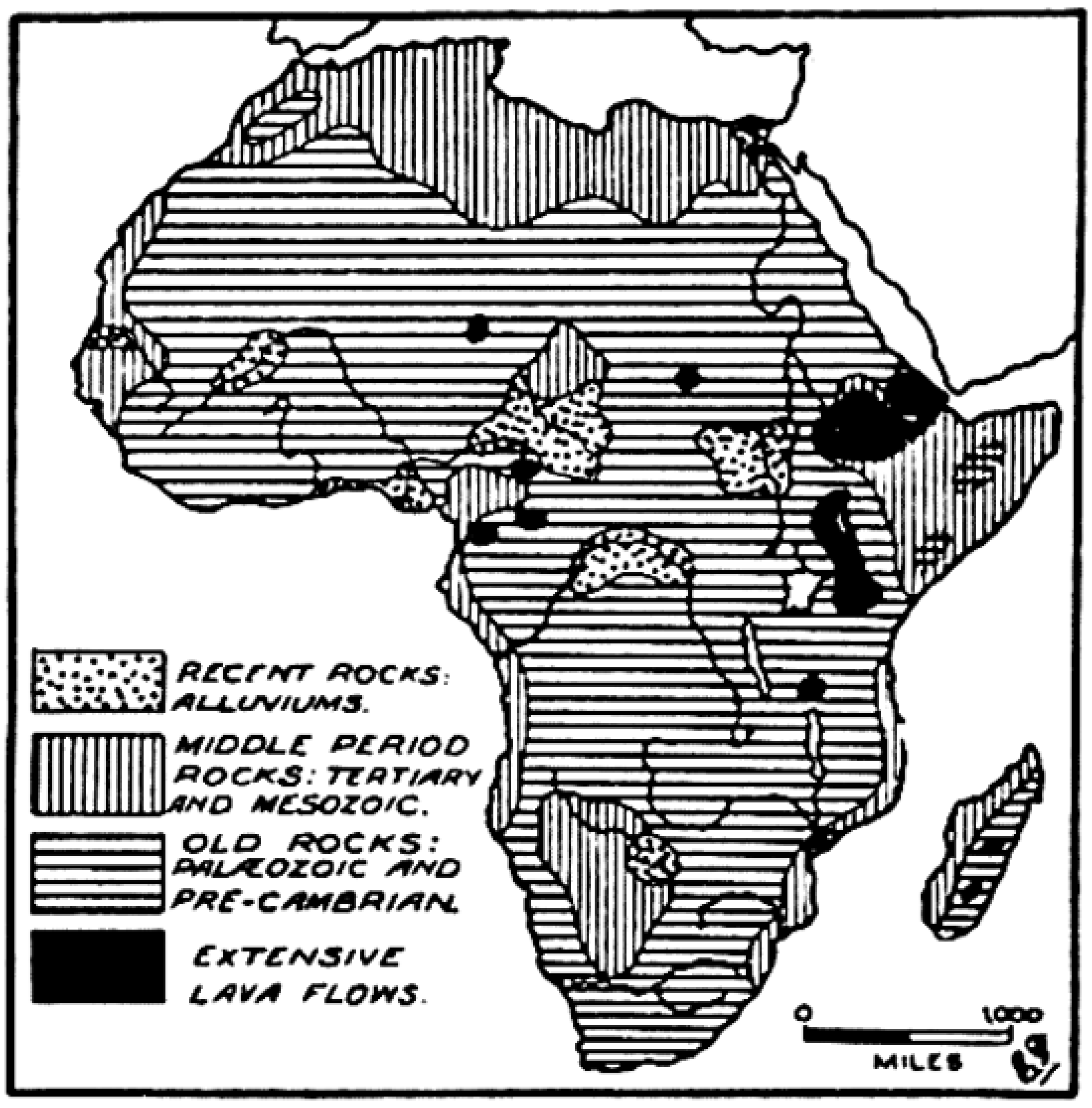


FIG. 7. *Simplified geological map of Africa to indicate the importance of rocks of early geological ages in the continent.*

The lava flows of East Africa and Ethiopia occurred in conjunction with the formation of the Great Rift Valley. They have weathered into fertile soils and are important areas of both native and European farming.

## EXERCISES

1. All geography students should build up a vocabulary of the words and terms used in the subject with their particular geographical meaning. A good place to put such a list would be on the last five or six pages of your notebook and in making it the Penguin: "*A Dictionary of Geography*" will be found very useful. Start your vocabulary by listing the following words and their meanings: earth storm, fold mountains, peneplain, undulating country, erosion, basin, alluvial soils, continental shelf, horst, graben, sial, sima.

2. Using a good atlas (such as Bartholemew: *An Advanced Atlas of Modern Geography*, or Bartholemew: *Comparative Atlas*, or *The Oxford Atlas*) draw sections across Africa along the Equator, 30° S., and 10° N. parallels of latitude, and the 20° E. and 40° E. meridians of longitude. Do not over-exaggerate the vertical scale and name the important features along the line of section.

3. Describe the different landforms met with on a train journey from Cape Town to the Victoria Falls on the Zambesi River.

4. Divide Africa south of the Equator into its major physical regions and write a description of each region you have marked on your map.

5. Compare the general physical features of Africa south of the Tropic of Capricorn with Africa north of the Tropic of Cancer.

6. Compare the physical features of Nigeria with those of the Northern Territory. Also compare the landforms of Nigeria and Kenya.

7. Describe in some detail the general physical features of Abyssinia. You will need to go to the library and study a detailed African geography such as Stamp: *Africa*, or Fitzgerald: *Africa*, to answer this question.

| ERA | PERIOD | LENGTH (Approx.) Years | TOPOGRAPHICAL EVENTS | CLIMATE | LIFE (Biological features) |
|---|---|---|---|---|---|
| QUARTENARY | RECENT | ±25,000 | Present erosional forms | Warm | Modern man. |
| | PLEISTOCENE | 1 million | Ice ages, glaciation. | Cold and warm | Early man. |
| CENOZOIC (or Tertiary) | PLIOCENE | 6 " | Erosion cycle begins | Mostly uniform | Development of primitive types of present day mammals, birds, reptiles. Present day vegetation appears. |
| | MIOCENE | 15 " | Alpine mountain-building with much vulcanism. Major present fold mtns formed. | | |
| | OLIGOCENE | 20 " | | | |
| | EOCENE | 20 " | End of long erosional period. | | |
| MESOZOIC (or Secondary) | CRETACEOUS | 55 " | Wholesale land submergence – chalk deposits – some later coal seams. | Mostly wet and uniform | Extinction of dinosaurs. First appearance of modern plants. |
| | JURASSIC | 40 " | An erosional period — submergence — some vulcanism | | The Age of Dinosaurs — Abundant insect life – swamp vegetation. |
| | TRIASSIC | 30 " | Erosion and much deposition (e.g. Hawkesbury s.stone). Much vulcanism. | Wet Arid | Abundant and varied reptile life. Coniferous trees. |
| PALAEOZOIC (or Primary) | PERMIAN | 30 " | End of mountain building — Appalachian Mts formed. | Widespread aridity | Decline of fern trees. Rise of conifers. Reptiles and insects in great variety. |
| | CARBONIFEROUS | 70 " | Extensive mtn building (Armorican – Hercynian). Submergence when coal seams formed. | Wet and warm | Vast forests of quick-growing ferns. Appearance of amphibians, fishes and sharks. |
| | DEVONIAN | 40 " | Submergence and deposition. Widespread mtn. building (early Dev.) – Caledonian earth-storm. | Warm and wet Ice Ages | Abundant fishes with backbones and side fins. First amphibians and fern forests. |
| | SILURIAN | 40 " | Peneplanation — also large areas of emergent plains. | Uniform | Abundant corals. First fishes and first land plants. |
| | ORDOVICIAN | 40 " | Widespread deposition in shallow seas. Some mtn building (Canada, New Eng). | Wet | Abundant shellfish. No land plants or animals. |
| | CAMBRIAN | 100 " | Erosion, submergence with formation of sedimentary rocks. Mountain building in early Cambrian (Killarney storm). | Warm and Wet Ice Ages | First abundant fossils (shelled marine life inc. trilobites). |
| PRE-CAMBRIAN | PROTEROZOIC AND ARCHEOZOIC | 800 " (?) | Much mountain-building, folding, metamorphism and vulcanism. | ? | Primitive marine life mainly without bones or shells. |
| | AZOIC | 1000 " (?) | Obscured by time. | ? | No evidence of life – the early cooling stage. |

FIG. 8. *General geological time chart.*

# CHAPTER II

# CLIMATE AND VEGETATION

## General

Africa's latitudinal position would tend to give it generally warm or hot climates (i.e., average temperatures of 65° F. to 80° F.). The elevation south of the Equator results in some modification of the heat, especially in the cool season (see temperature maps for January and July).

The summers, even in the high plateau of the south, are characterised by very hot temperatures of up to 90° F. average. The dominant feature of the African summer conditions is the four million square miles of North Africa with over 80° F. average temperature from June to September.

North Africa is very little affected by sea influences because of its size and general relationship to the land mass of Eurasia. The narrowing peninsular projection of southern Africa shows an increasing sea influence, though the disposition of mountains and the high eastern plateau scarp tend to lessen oceanic effects towards the western interior.

The fact that Africa is bisected by the Equator tends to give a remarkable similarity between its northern and southern climates. There is a rough parallelism of the climatic regions, as is noted in a later discussion.

## Examination of Seasonal Climatic Maps

For the time being it will be sufficient to study the six maps in Figure 9 and leave any explanations of them to a later part of this chapter.

### 1. January conditions.

(*a*) *Temperature.* This is the middle of the southern summer period and the heated portion of Africa is mostly south of the Equator. The effect of elevation is clearly shown, for only on the Mozambique coastlands, the Guinea coasts and in parts of the Congo Basin is the average temperature over 80° F. (i.e., very hot). Much of Cape Colony and all of Africa north of 15° N. have warm or cool conditions, while parts of the Atlas Mountains have cold temperatures with occasional snowfalls.

(*b*) *Pressure and winds.* An enormous area of *high* pressure occupies all of north Africa and extends eastwards into Asia. There is a general outpouring of winds from the continental air mass over the Sahara resulting in a season of fine weather with warm sunny days and clear frosty

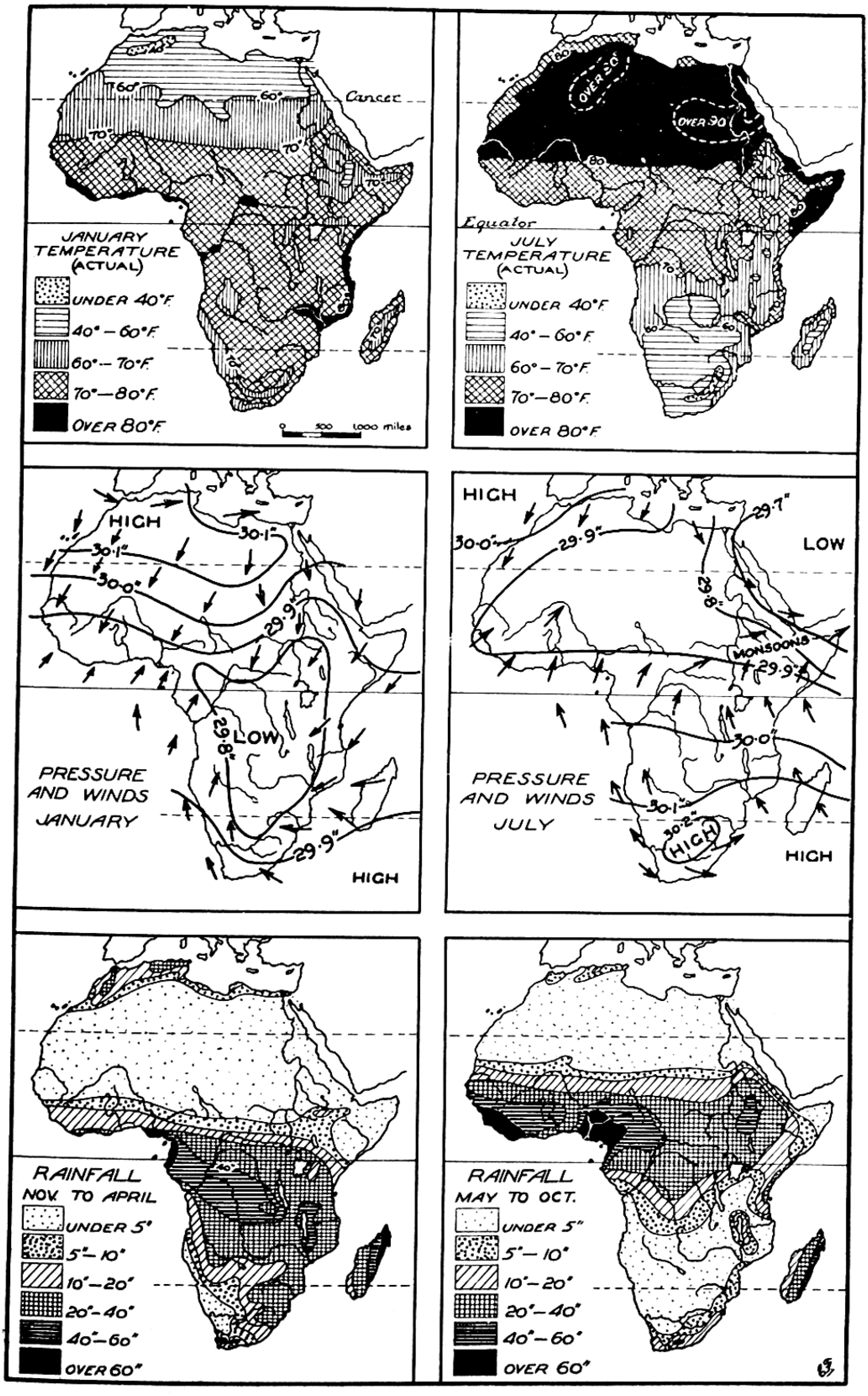


FIG. 9. *January and July temperatures, pressure belts and wind systems, and rainfall distribution for summer and winter in Africa.*

nights. The Atlas Mountains region is under the influence of westerly winds associated with the southern margin of the marine air mass of the North Atlantic Ocean. These winds bring moderate rains to the area.

South of the Equator there is a widespread though weak *low* pressure area which creates convectional rain conditions along the Guinea Coast and in the Congo Basin and causes an inflow of winds from the adjoining oceans. Those coming from the Indian Ocean are warm and moisture laden and bring much rain to the whole eastern half of southern Africa. Their rain effectiveness is increased where they are forced up over mountain barriers or high plateau scarps as in Natal, Mozambique or Madagascar.

The inflowing winds from the Atlantic pass over the cold wall of the Benguela Current and are not rain bringers. They do create fogs where they meet warmer land winds along the west coast areas.

(*c*) *Rainfall.* The rainfall map for the southern summer period (November to April) reflects the pattern of winds and pressure areas.

The heaviest rains occur in the Congo Basin, Nyasaland and Madagascar, where the major causes are first, convectional rains, and secondly, orographical rains on the windward slopes of highlands. The over 60-inch patches result mainly from the latter cause.

The Guinea coastlands have a moderate rainfall partly from convectional rains and partly from on-shore winds. North Africa is almost rainless except for the Barbary States and light falls along the Mediterranean coastlands.

**2. July conditions.**

(*a*) *Temperature.* The vertical rays of the sun are now in the northern hemisphere and the huge mass of the Sahara becomes intensely hot. Notice that quite large areas have an average reading of over 90° F., which means that the average maximum readings during the day-time would exceed 100° F.

Southern Africa now experiences cool conditions generally, with cold temperatures on the Drakensberg Mountains. The only moderate temperatures north of the Equator are found in the high (c. 7000-9000 ft.) Abyssinian Plateau.

(*b*) *Pressure and winds.* During this period a huge *low* pressure area builds up over southern Asia and extends into northern Africa. The inpouring air to this low creates marked monsoon effects on the Guinea Coast and in Abyssinia, where the high volcanic plateaux and ranges bring about heavy rainfalls.

The convectional rain belt now moves north over the Chad-Ghazal area to bring moderate rains to those lands and heavy rains to the lands farther south and nearer the Equator.

Southern Africa, under the influence of a *high* pressure and a continental air mass, has outpouring winds which bring little rain.

Cape Colony is now affected by the westerly winds associated with the Antarctic sub-polar marine air mass and receives moderate rains.

(*c*) *Rainfall.* The heaviest rains occur on the Guinea coastlands, in the Cameroons, on the Abyssinian Highlands and generally throughout the convectional rain belt between the Equator and 12° N. latitude.

Cape Colony, the Natal coast and the Nyasa highlands receive moderate rains, while eastern Madagascar gets quite heavy rains where the south-east trades ascend the eastern scarp of the highlands.

## World Pressure Belts and Wind Systems.

In the discussion on Figure 9 several terms relating to air pressure, winds and convectional rainfall were used. Let us pause in our discussion of African climate to explain them.

**1. World pressure belts.** Air pressure is not an element of climate, for its variations, even where they are greatest, are not noticed by humans and

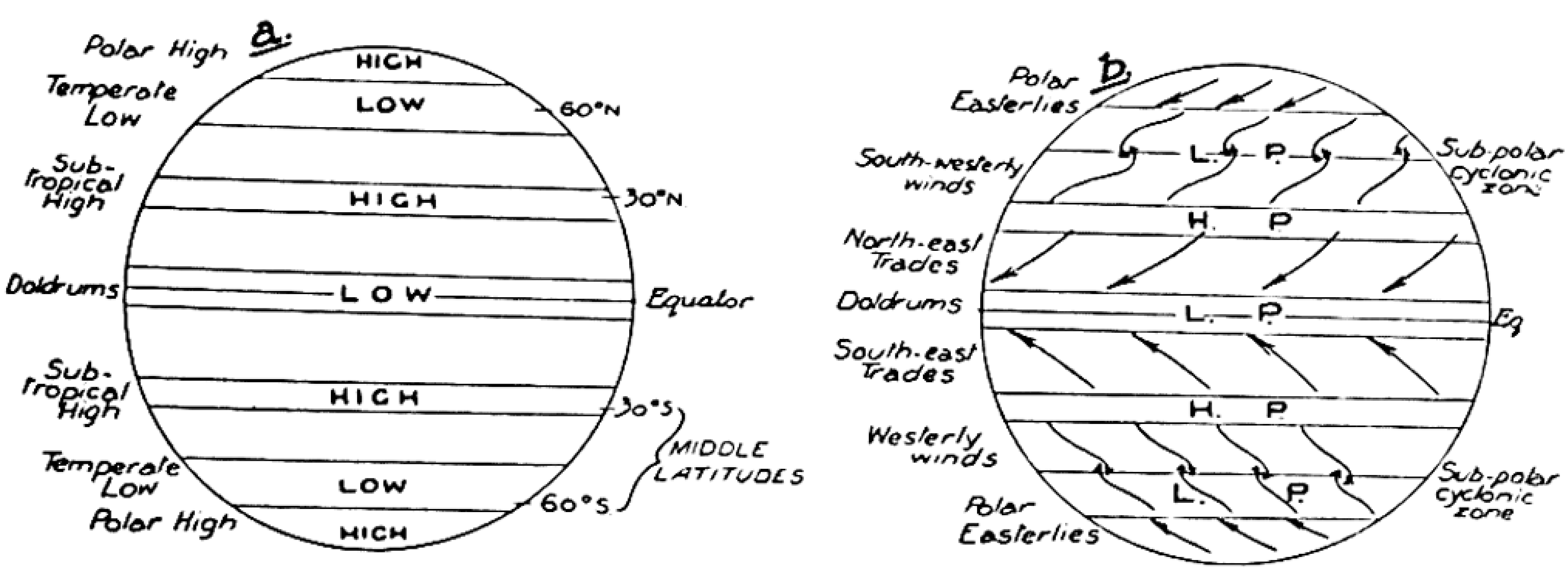


FIG. 10. *Diagram of the ideal distribution of pressure belts and major wind streams on a rotating globe.*

can be measured only with delicate instruments. Indirectly, however, air pressure, as the main factor controlling the wind systems, may be regarded as a fundamental climatic element. Climate probably depends more on *air masses* and the prevailing winds than on any other single factor. (See Section III, Chapter XXIII for an explanation of air masses.)

The distribution of pressure on the globe results principally from the decrease in temperature from the Equator to the poles plus the effect of rotation on the axis. Figure 10(a) shows the major pressure belts as they would appear on a uniform rotating globe. The only portion of the actual globe where they approximate to this is over the Pacific Ocean. Elsewhere the presence of large continental land masses causes profound modifications (see later). The names of the belts are shown on the left.

**2. Major wind systems.** In Figure 10(b) the wind systems that would occur on such a uniform globe have been added with their names on the left side of the diagram. Again, these ideal winds are greatly modified on the actual globe by the mingling of land and water over its surface. From Figure 10(b) we see that the principal winds are the north-east and south-

east trades in the tropical areas; the westerlies (south-west and north-west) in the middle latitudes (30° to 50°); and the polar easterly winds in the polar and sub-polar latitudes.

**3. Movement of pressure belts.** Since the earth revolves round the sun with its axis tilted constantly in the same direction, the vertical rays from the sun move from tropic to tropic and back again. Thus on 22nd June the vertical rays fall on the Tropic of Cancer, while on 22nd December they fall on the Tropic of Capricorn.

This movement of the vertical rays is accompanied by a north and south movement of the belt of heat caused by them and in turn by a similar movement of the equatorial low pressure belt.

This swing of the pressure belts and the wind systems through some 15° of latitude is a cause of alternate wet and dry seasons in lands on the poleward margin of the sub-tropical *high* (i.e. the Mediterranean lands) and on the equatorial side of the same *high* (i.e. the savanna lands). We will learn more about the latter in the section on convectional rains later in this chapter.

**4. Land masses.** The addition of land masses causes further complications in the wind systems resulting from variations in pressure distribution caused by the unequal heating and cooling rates of land and water.

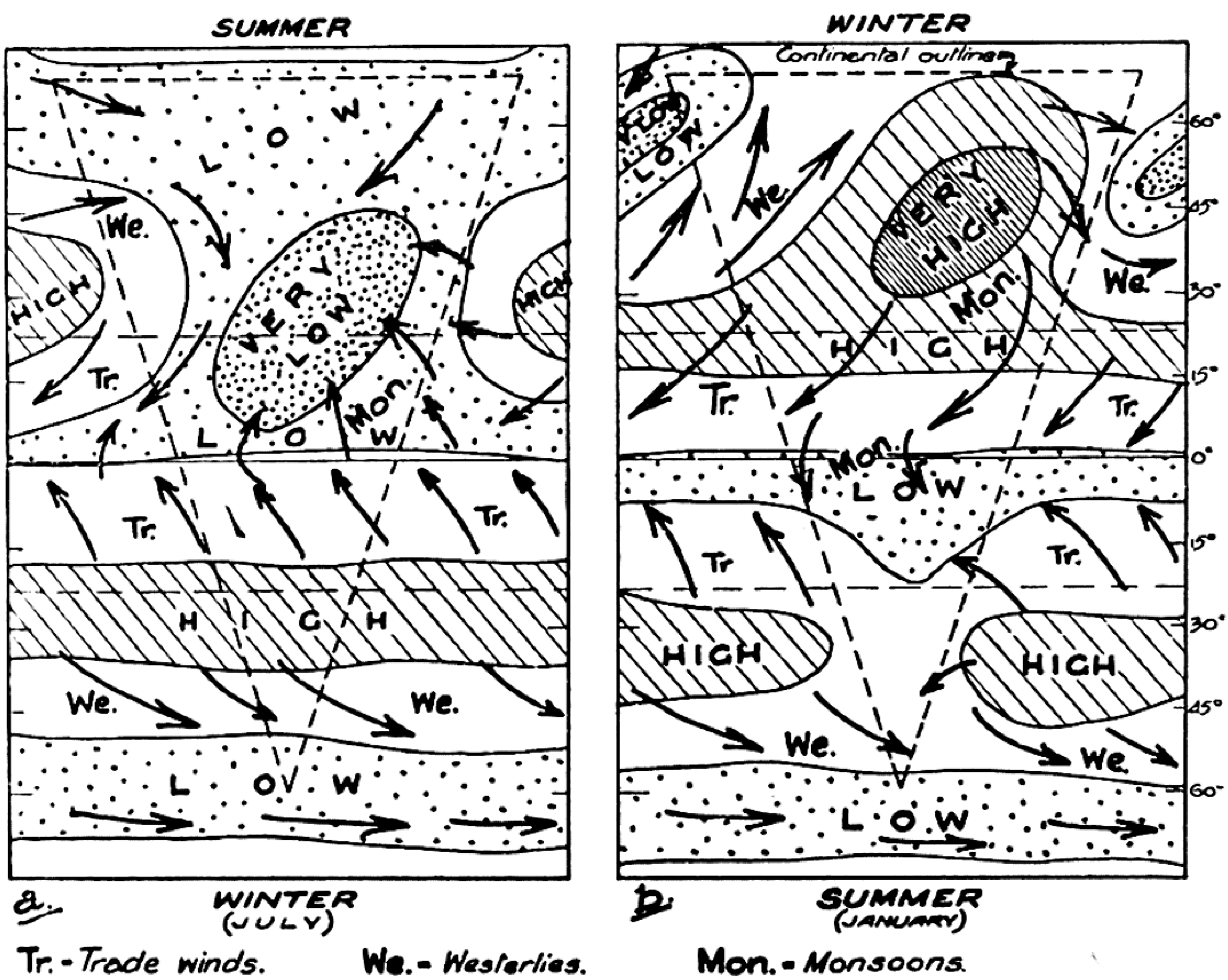


FIG. 11. *Diagrammatic sketch of surface pressure and winds on a continental land mass and the adjoining oceans.*

Figures 11(a) and 11(b) show some of the more important changes in a diagrammatic form. These figures are based on diagrams in Kendrew's *Climates of the Continents*, page 23. You should get it from the library and read more about this important matter.

A comparison of Figure 11 with Figure 10 will show that the greatest variations in pressure and winds occur in the northern hemisphere, which is known as the Land Hemisphere. Here a powerful *low* pressure in *summer* and a strong *high* pressure in *winter* over the land masses bring about the bi-annual swing of winds known as the monsoons. You should try to relate this diagram to actual maps shown in atlases or text-books dealing with the monsoon winds.

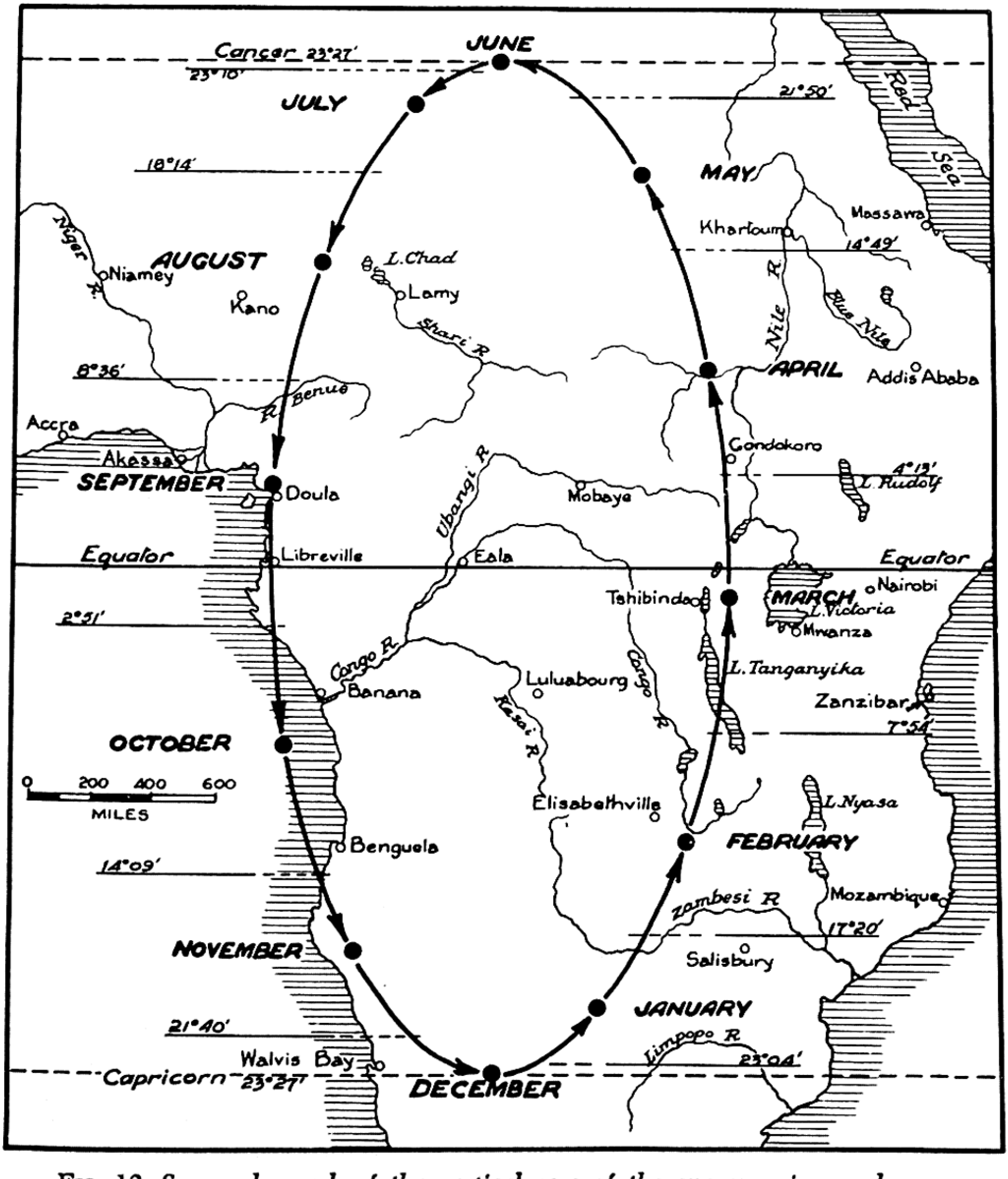


Fig. 12. *Seasonal march of the vertical rays of the sun superimposed on a map of Africa.*

## Convectional Rains and Movement of Rain Belts

Africa affords a good example of the development of convectional rain areas and their movement north and south following the vertical rays of the sun.

Figure 12 shows the high (vertical) sun position throughout the year. The path of the rays is shown as an oval in order to make it easier to follow. In actual fact any given bundle of rays would move almost directly north and return over practically the same path. The exact position of the rays at any time may be determined by reference to the months and the latitude lines indicating the rays' position at the beginning and end of each month. Thus, in February the vertical rays pass from 17° 20′ S. to 7° 54′ S., and in May from 14° 49′ N. to 21° 50′ N.

This map also shows that all inter-tropical towns have vertical rays twice during the year. Thus Benguela (lat. 14° S. approx.) has vertical rays at the end of October and again at the middle of February; Khartoum gets its vertical rays in the first week of May and again in the second week of August. Eala (on the Equator) has its vertical rays on 22nd March and 22nd September, while Walvis Bay (on the Tropic of Capricorn) would get only one period of vertical rays: for a few days round 22nd December.

Convectional rains develop in the zones of calm found in the belt of greatest heat (the heat equator) close to the vertical rays of the sun. Here the heated surface air expands and, in the absence of winds, rises carrying immense quantities of water vapour with it. Rapid cooling of the upward moving air currents, once they reach 5000 feet elevation or higher, causes vigorous condensation of moisture to create thunderstorm conditions with great air turbulence and heavy downpours of rain. These occur daily at about mid-afternoon near the centre of the hot belt where conditions are most intense.

This belt of convectional rain stretches over approximately 14° to 16° of latitude and moves north and south with the heat equator. The centre of the belt lags somewhat behind the vertical rays of the sun and moves from approximately 14° N. to 12° S. latitude. The edges would therefore reach to about 22° N. and 20° S. latitude.

Rainfall is heaviest near the centre, where it amounts to from eight to twelve inches per month (two to three inches per week). It tapers off to one or two inches a month at the edges. The diagrammatic cloud drawn at the top of Figure 14 is intended to show this.

As this broad belt of rain moves north and south with the high sun, it causes the other rain belts to move with it. Figure 13 shows this point diagrammatically in three diagrams. In studying them, note first the position of the sun in each of the diagrams and secondly the manner of movement of the wet belt (convectional) and the dry belt (desert). Notice that the Equator gets some rain in each of the three diagrams but would have its maximum falls in March and September, when the centre of the rain belt is over it; i.e., it has a clear double maximum rainfall. On the other hand the tropics get no rain at all other than a few storms in their respective summers, while places at about 25° north or south latitude would theoretically be rainless. It is important to keep this diagram in mind when studying African climates or the climates of any inter-tropical and sub-tropical lands.

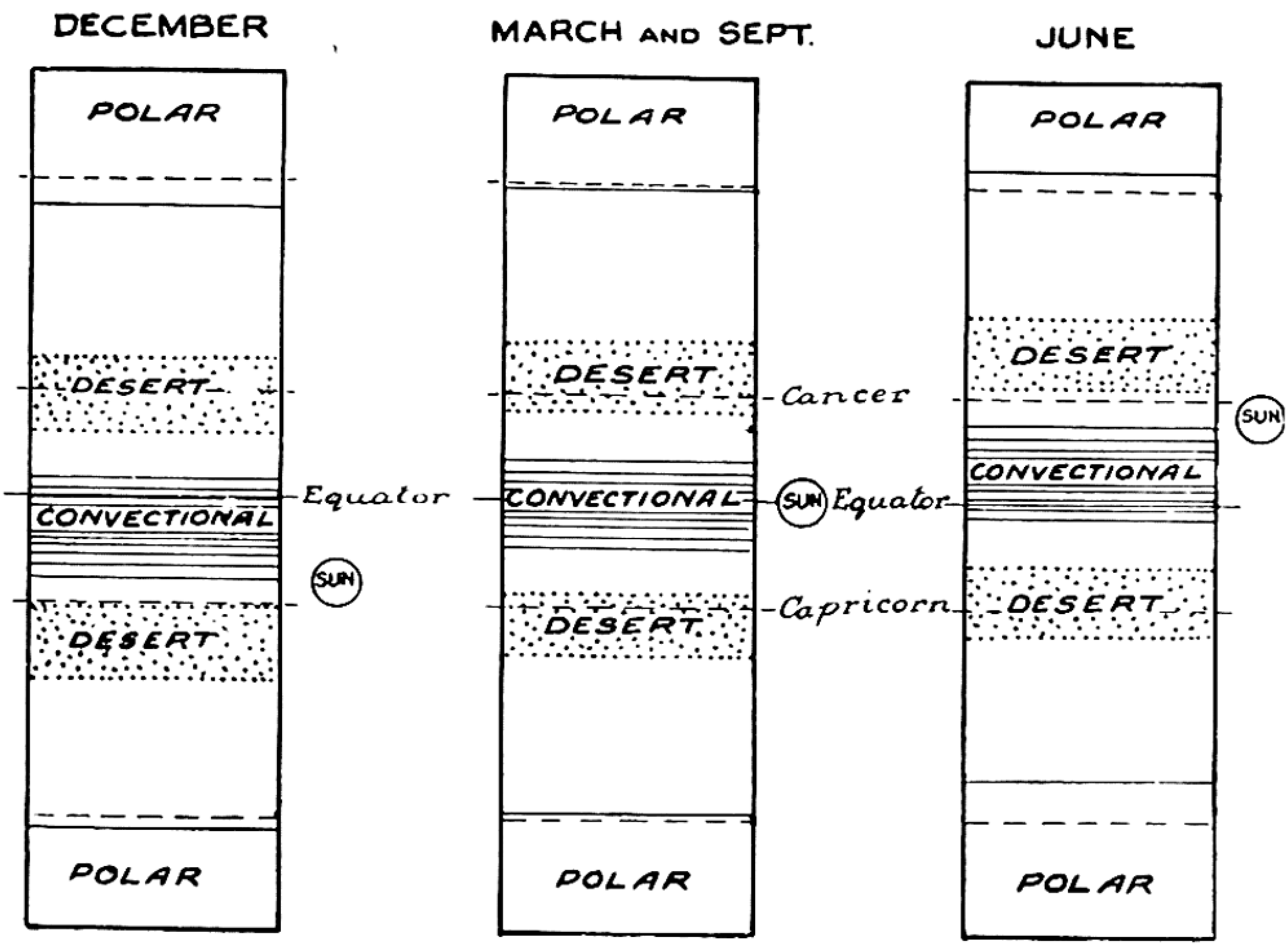


Fig. 13. *Diagrammatic sketch to show the seasonal movement of the major rain belts in tropical and sub-tropical regions.*

## The Pattern of Rainfall from Convectional Rains

Figure 14 will repay careful study, as it is an attempt to relate the theoretical rainfall with the actual recorded monthly rainfalls of many inter-tropical African towns.

The graphs are arranged in two sets of three graphs for each latitude stated: 0°, 5° N., 10° N., 15° N.; and 0°, 5° S., 10° S., and 15° S.

As the broad belt of convectional rainfall moves north and south over inter-tropical lands it creates a definite pattern of rainfall distribution. In theory this should vary from a double maximum, high annual total type within a few degrees of the Equator, to a single maximum, moderate to low annual total type beyond about 12° north or south latitude. These theoretical distributions are summarised in the top line of each of the two sets of three graphs in Figure 14.

The graphs for actual towns under the theoretical columns show how close is the reality to the theory. When studying them, it is necessary to remember that the theory could only correspond with fact if the land were a level plain at very little elevation above sea-level. When one remembers the great differences in landforms throughout the inter-tropical African scene the correspondence between theory and actuality is rather astonishing. Check for example: (*a*) Eala and the theoretical equatorial graph; (*b*) Djougou or Natitingou and the theoretical 10° N. graph; (*c*) Niamey and the 15° N. graph. South of the Equator we might note the graphs of Nyundo,

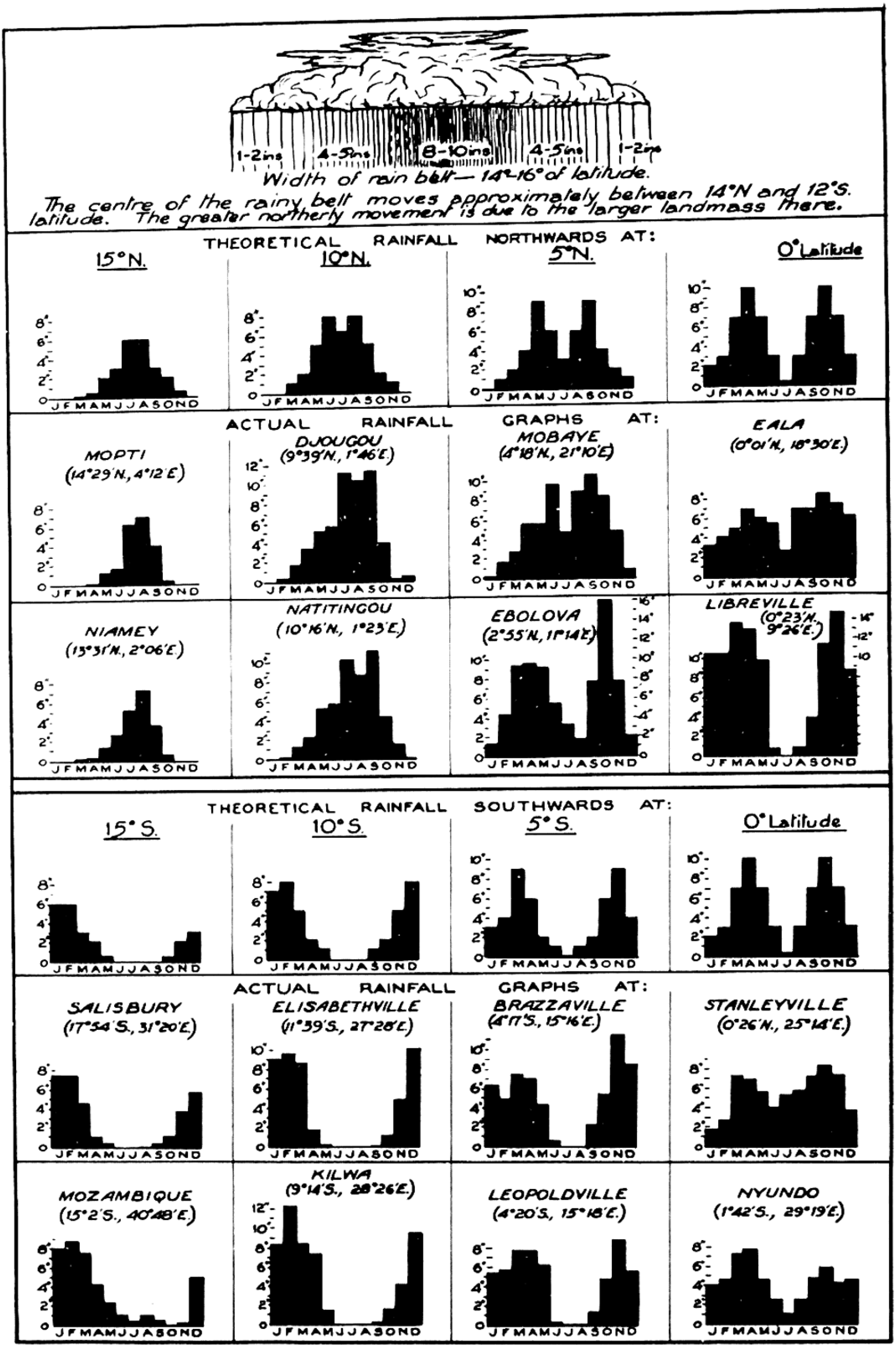


FIG. 14. *Pattern of rainfall resulting from the movement of the convectional rain belt over Africa.*

Brazzaville, Elisabethville and Salisbury and their corresponding theoretical rain graphs.

The general characteristics of the convectional rain belt are constantly hot and humid conditions with little windy weather and many thunderstorms. The length of the season experiencing these conditions depends on the latitude. On the Equator it is practically year-long, but at 15° north or south latitude it lasts for a few months only.

The graphs (both theoretical and actual) show the double maximum of rain at and near the Equator. As stated above, this double maximum persists outwards to about 10° latitude. Notice however that at the Equator the peaks of rainfall are six months apart but they gradually move together until in latitude 10° to 12° they merge into a single maximum. When reading the graphs, do not become confused with the southern hemisphere set. There, a maximum in December and January (i.e., at each end of the graph) is not a double one, since December and January are adjacent months.

## Annual Rainfall and Seasonal Rain Distribution

The annual rainfall map is the first of the distribution maps where the general effect of Africa's position astride the Equator may be seen. Look at Figure 15 and notice how the near-equatorial areas form a heavy rain core round which are grouped, northward and southward, zones of successively decreasing rainfall until the deserts are reached. Then, beyond about latitude 30° north and south, wetter zones again appear in the Atlas Mountains and the Cape Colony-Natal area.

The greater part of the central African over-40-inch rainfall area gets its rain from the movement of the convectional rain belt as described above. In the Gulf of Guinea and on the Grain Coast of Sierra Leone and Liberia, the falls are greatly increased by orographical rains from on-shore summer monsoons (see the graph for Freetown in Figure 20).

The heavy rains on the east coast of Tanganyika, Mozambique, Natal and Madagascar are mainly the result of the on-shore south-east trade winds being forced up and over the high plateau scarp. Abyssinia has a patch of 40-inch—60-inch rainfall caused when the monsoon winds meet the high plateaux there.

Surrounding the central wet core is a broad belt which receives from 10 to 40 inches of mainly summer rainfall. This is the savanna land. Beyond it lies the desert, consisting of over four million square miles in the north and north-west and about half-a-million square miles in the south-west. The savanna and desert are much more truly typical of the African scene than the forests of the high rainfall belts.

The seasonal distribution map (inset on Figure 15) merely emphasises the great significance of summer rains throughout all Africa except the extreme north and south margins.

Even where the rain falls at all seasons, as in central Africa, there is a greater amount during the high-sun period (i.e., summer). The huge permanently arid areas are also worth noting, as they offer a major

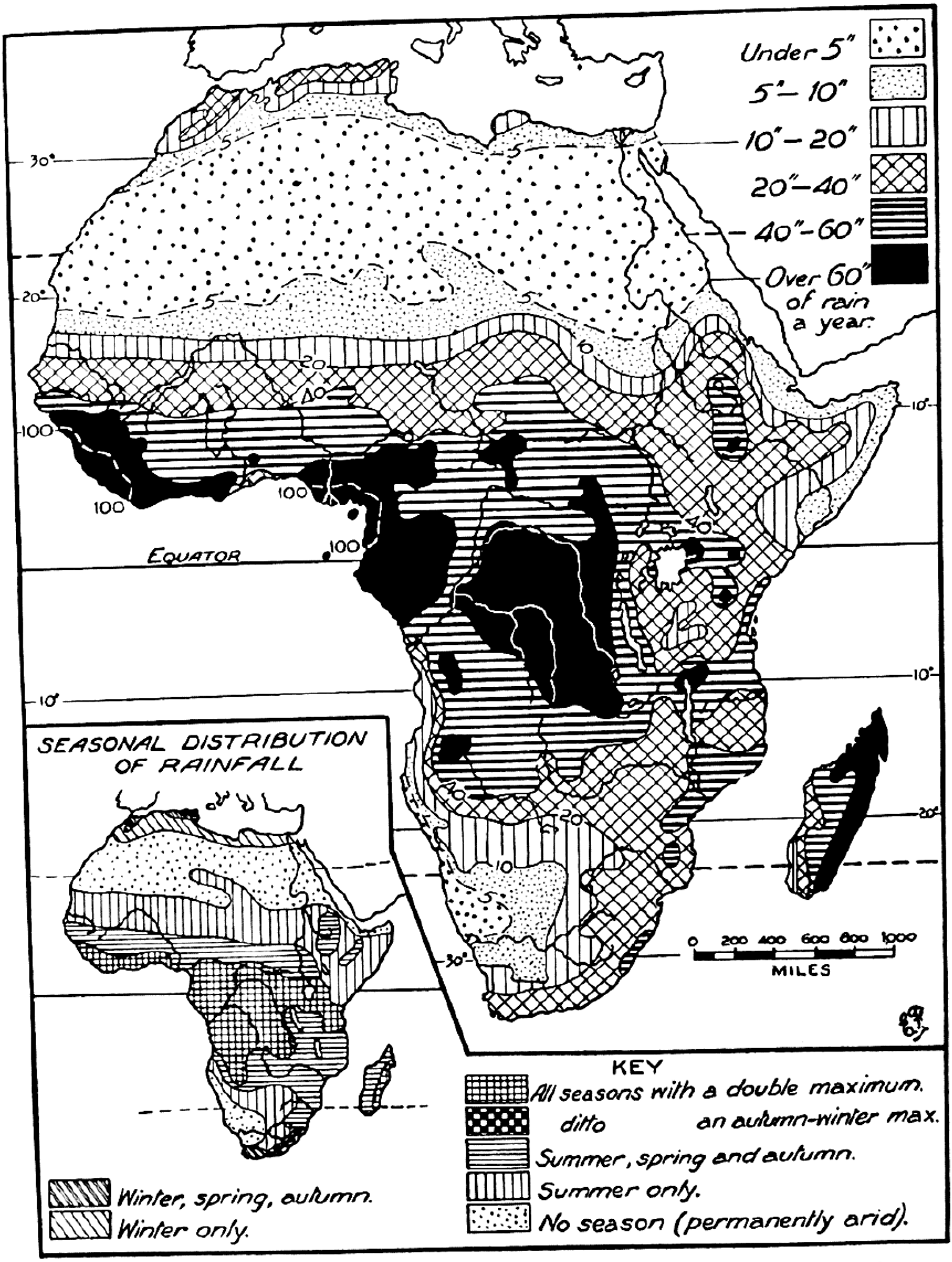


FIG. 15. *Distribution of the annual rainfall over Africa with inset map of the seasonal rainfall regime.*

challenge to man's use of the continent, as also does most of the land receiving less than 20 inches of rain a year. The other great challenge comes from the very high rainfall areas with their fast-growing vegetation and their many and deadly insect pests.

## Climatic Types

Before studying the African climatic regions it will be as well to understand what is meant by a climatic type and something of how climatic types are arrived at. Climate is mainly a summation of temperature and rainfall, and if we study the general pattern of temperature and rainfall over the whole earth we will find that there are certain zones or belts with very fixed and constant (in the sense of being year-long) types of climate. It may be difficult to mark their boundaries with great exactness, but it is not at all difficult to be aware of their existence. These fixed and stable climates are:

(1) the equatorial hot and wet;
(2) the tropical hot and dry;
(3) the middle-latitude cool and wet;
(4) the polar cold and dry.

In all cases the climatic character is constant throughout the year. Now look at Figure 16(a). The rectangle here represents a piece of the earth's surface stretching from pole to pole and of continental width. On it the constant types of climate have been shaded as well as named. Now

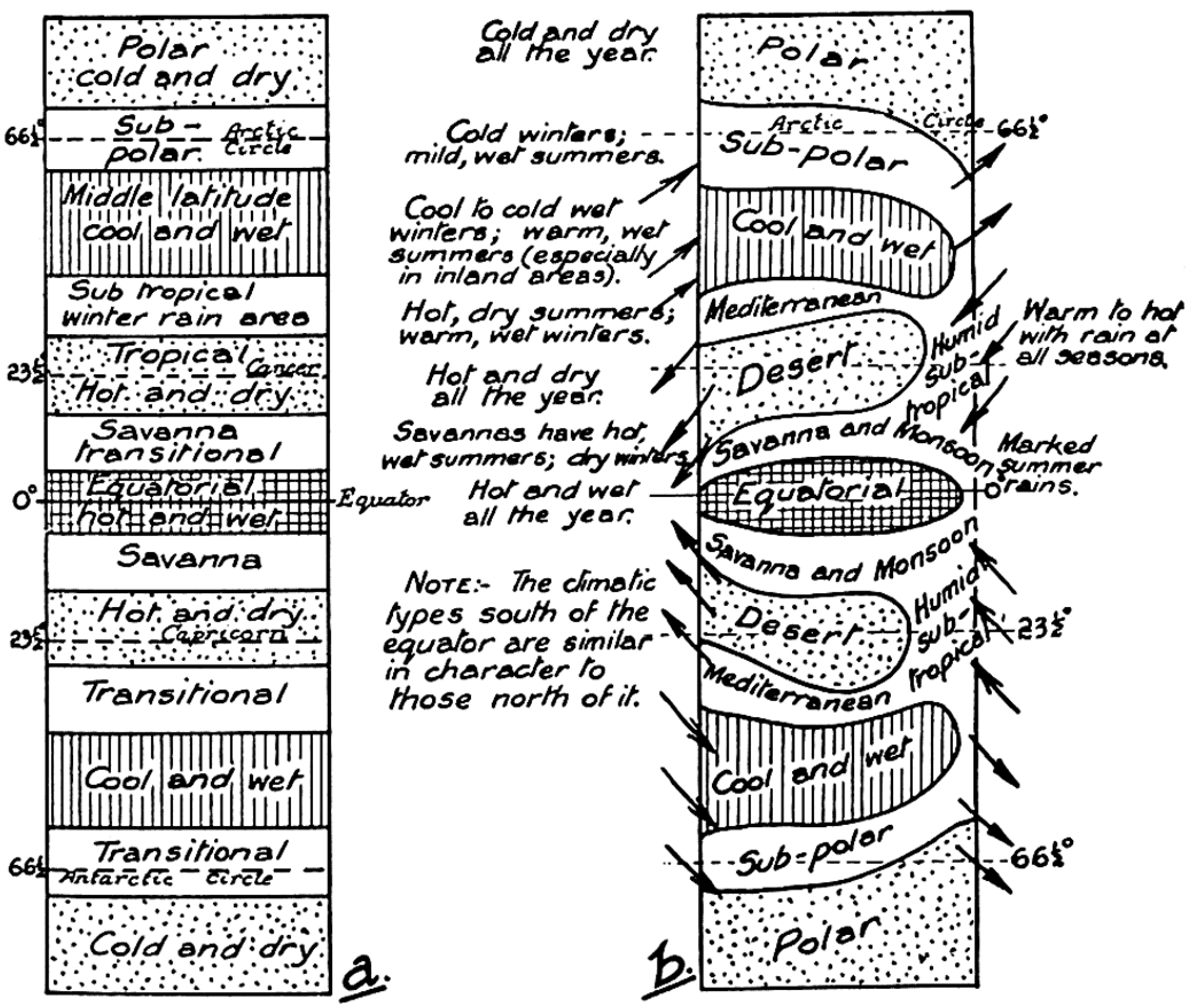


FIG. 16. *Summary of distribution of climatic types throughout the world.*

notice that between each constant type there is a broad transitional zone or belt, which, because of the north and south movement of the pressure belts, wind systems and rain systems, receives the climate of both of the constant types on either side of it. Thus the savanna transitional has hot wet summers and hot dry winters; the sub-tropical winter rain area (the so-called Mediterranean type) has cool wet winters and hot dry summers; and the sub-polar type has cool wet summers and cold dry winters.

If we now add the main wind streams (trades and westerlies) to our diagram (as in Figure 16(b)) we introduce further variation and our pattern of climatic areas approximates much more closely to the actual. The on-shore trade winds and the monsoon winds give a wet all-the-

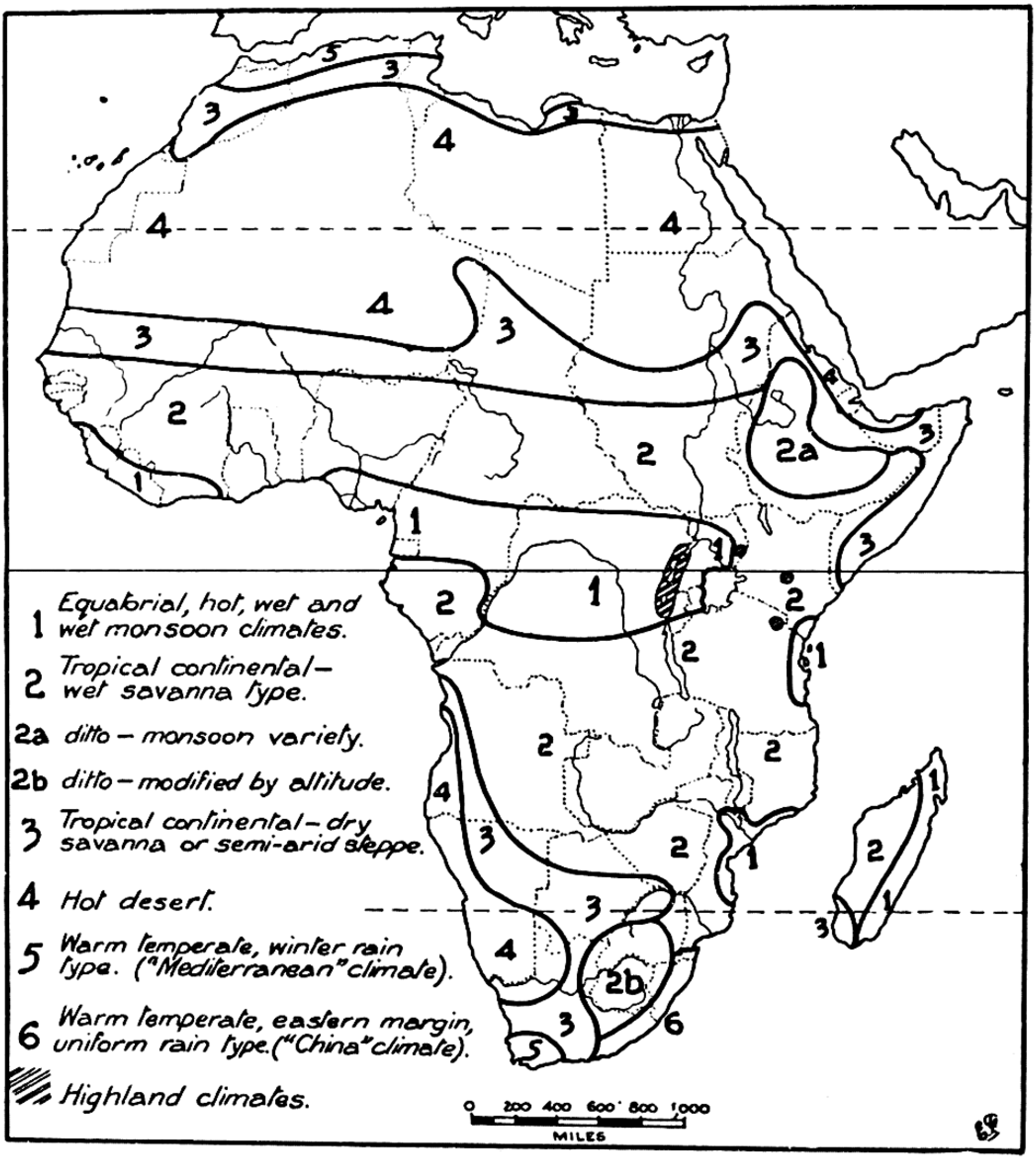


FIG. 17. *Distribution of major climatic types in Africa.*

year rainfall area to the eastern coasts in the latitude of the deserts on the western sides and the continental interiors (e.g., coastal Queensland and Western Australia between 15° and 25° latitude). Again, the development of monsoon conditions on the tropical eastern coastlands (see Figure 11) gives very heavy summer rains there, while the off-shore westerlies in latitudes 50° and 60° change the cool and wet climate to sub-polar.

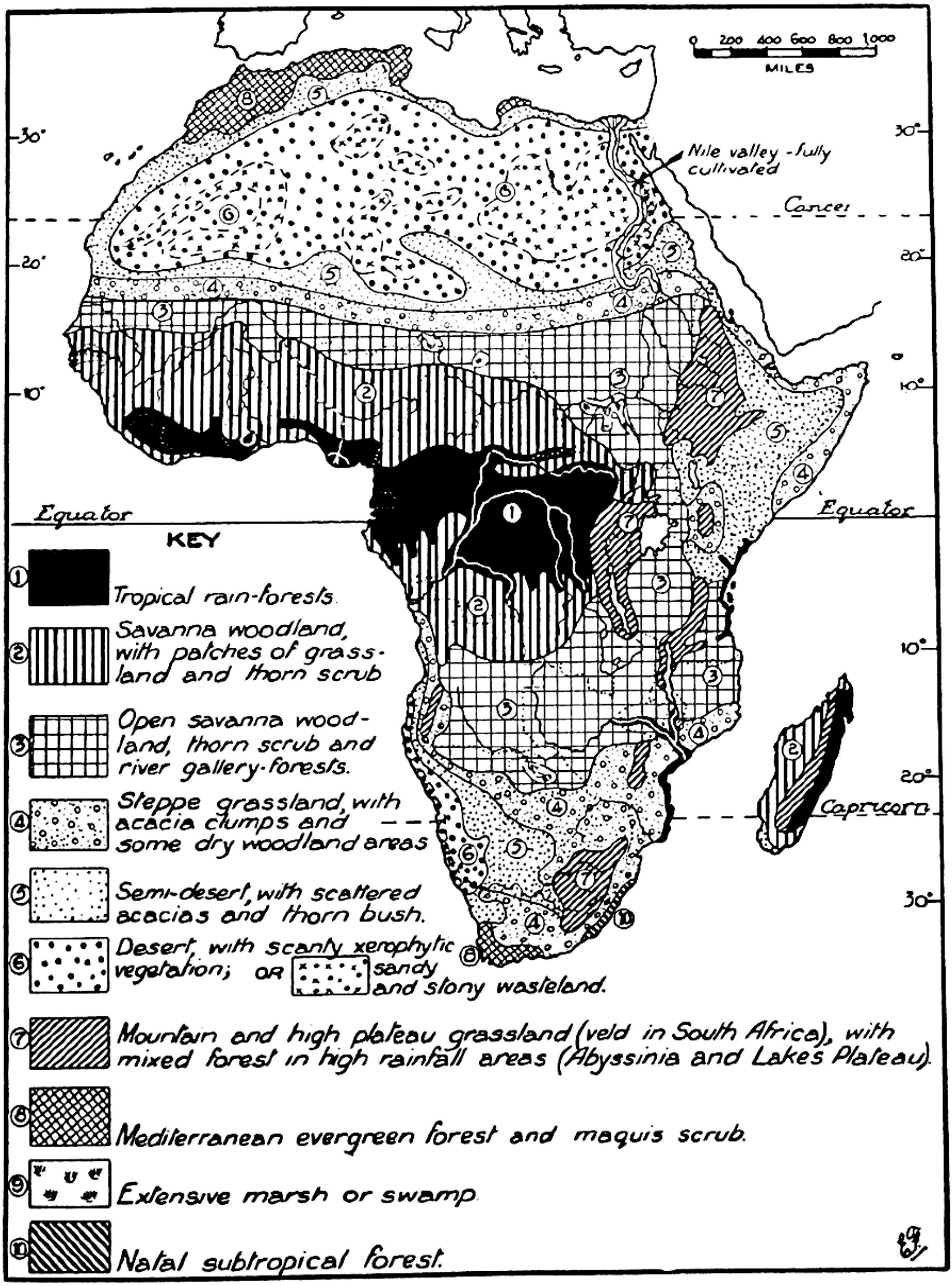


FIG. 18. *Principal vegetation regions in Africa.*

This is now a diagram summary showing the main climatic types throughout the world. There are some extra ones caused by large areas of highland or by the enormous Asian land mass, but this pattern is reasonably true to the actual distribution. The notes alongside Figure 16(b) summarise the character of each of the types shown and the shaded areas correspond to those in Figure 16(a).

Examine the temperature and rainfall conditions as summarised and notice that there are always one or two features which distinguish each of the types named from the others. Thus the Mediterranean has hot dry summers and warm wet winters, while the humid sub-tropical has a similar climate but with summer rain as well as winter rain, and the savanna and monsoon types differ in the amount of rain and its origin: monsoon areas have heavy rains brought by winds, while savannas have moderate rains mainly from convectional storms.

## African Climatic Types and Vegetation

These two features will be studied together, as there is a close similarity between the general pattern of each (see Figures 17 and 18).

There are only two major or constant climates in Africa: the desert (Number 4, Figure 17) and the hot-wet equatorial (Number 1, Figure 17). All other types are in some way transitional in character. Numbers 2 and 3 on the map are both savanna transitional, 3 being drier than 2. Number 5 is the Mediterranean type, transitional between the hot desert and the cool moist climate of western Europe. Number 6 is the Mediterranean type modified by the on-shore south-east trades as explained in Figure 16(b).

Figure 17 also shows that Numbers 2, 3 and 4 are the dominant African climates and Figure 18 shows that the savanna woodland, grassland, acacia scrubland and the desert (Numbers 2, 3, 4, 5 and 6) are the resultant characteristic vegetation types. It is quite wrong to regard Africa as a land of jungles; it is a continent of woodland, grassland and desert.

**Number 1 Type: Equatorial hot-wet climate,** which includes the wet monsoon areas of the Guinea coastlands. Monotony is the keynote of this climate. It has an all-season rainfall of over 60 inches a year, with a tendency to a double maximum in the Congo Basin and very heavy monsoon summer rains on the Guinea Coast (see rainfall graphs, Figure 20). Temperatures are high all the year, with averages above 65° F. for each month. The humidity is high, especially during the rainy seasons.

*Vegetation.* The essential characteristic of these areas is an intricate pattern of ever-full streams fringed by impenetrable jungle walls. These evergreen forests also cover the low interfluves between streams and are composed of broad-leafed trees in two distinct levels, with innumerable interlacing vines and many epiphytes (plants growing on other plants

and obtaining their food from the air) in the upper branches of the tall trees. There is little undergrowth, since the forest floor is dark and dank.

Along the coasts the forest is flanked by swamps and mangrove forests. Here Nature is slowly reclaiming and stabilising the mud flats, as is shown in Figure 19.

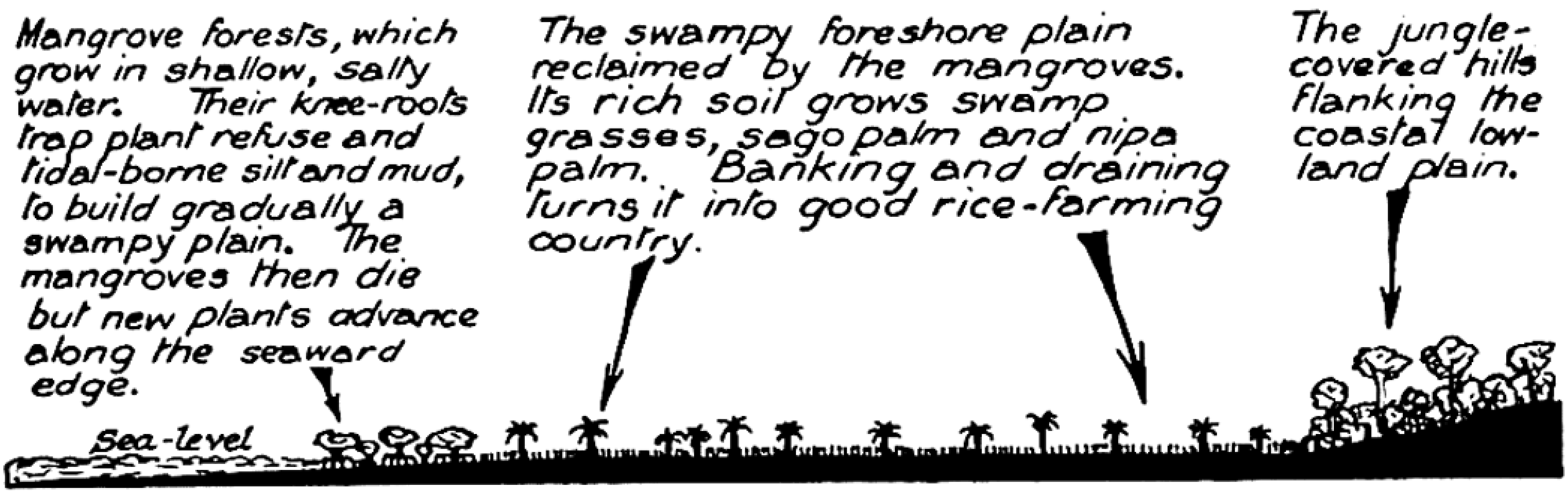


FIG. 19. *Diagram summary to show how mangroves reclaim swampy foreshores.*

The forests contain many valuable commercial timbers such as mahogany, ebony and walnut, and commercial trees like oil-palm, rubber and silk-cotton. Lumbering is difficult and costly because of the boggy nature of the ground and the manner in which the valuable trees are mingled haphazardly with useless species. Gathering commercial products is essentially a part-time native occupation, but plantations are increasing in importance in cleared jungle where native labour can be recruited for work (see Part II, Chapter XII).

*Animal life* is varied, consisting of innumerable highly coloured birds, hosts of monkeys and many reptiles, with elephants and the hippopotamus appearing towards the edges of the forests.

**Number 2 Type: Tropical continental or wet savanna.** This is basically a broad (800-1200 miles) transitional zone between the equatorial hot-wet and the arid and semi-arid lands. Its climate is characterised by hot wet summers and mild to warm and dry winters. The high-sun rainy season varies in length from eight months on the equatorial side to four months on the dry (or polar) side and the amount of rainfall ranges from 60 inches a year to 20 inches. Humidity is high in the summer months, when the conditions approximate to the equatorial type, and low in winter, when semi-desert conditions prevail.

The southern portion has a slightly milder climate because of greater elevation. The winters especially tend to be cold here.

The east African section is really an equatorial type with a double maximum of rainfall modified by an elevation of 5000 feet or more.

Two minor variations occur in Abyssinia (Number 2(a) on the map) and the High Veld (Number 2(b) on the map). Abyssinia is influenced both by

monsoon rains of considerable intensity and by an altitude of over 7000 feet; and the High Veld is affected by altitudes between 5000 and 8000 feet to experience one of the coldest climates in Africa.

*Vegetation* varies with the changing climates from open forest and woodland in the wetter areas (Number 2 on Figure 18) to mixed savanna woodland and grassland association in the drier and higher areas. Here are found the scattered umbrella-shaped trees and medium tall grasses with gallery forests along the rivers. This is essentially the typical African vegetation. South of 10° S., where the rainfall is heavier, much of the country is covered with a semi-deciduous forest.

*Animal life.* These woodlands and grasslands are the home of the many herbivores (deer, zebra, giraffe, etc.) and the carnivores (lion, cheetah, jackal, etc.) that prey on them.

**Number 3 Type: Continental dry savanna or semi-arid steppe.** In North Africa this is a 100 to 200-mile wide belt fringing the Sahara and extending eastward through Somaliland. In South Africa the dry savanna lands are much more extensive, as they occupy most of the inland south of the Zambesi.

The rainfall of these areas is a scant eight to twenty inches a year and is markedly seasonal. It is related to the season of the adjoining wetter lands; i.e., winter rains where near the Mediterranean lands, and summer where alongside the wet savanna regions.

Temperatures are strongly continental in type, with extremely hot summers (often averaging over 100° F. in the hottest month) and mild winters with cold nights and warm sunny days.

*Vegetation* (see Types 4 and 5 on Figure 18). These harsh climates support mainly thorn bushes, acacia scrub and poor steppe grasslands in patches where soils and moisture are suitable. Many ephemerals (short-lived annual plants) appear after rainstorms, and these are utilised by the nomad pastoralists who inhabit these lands.

*Animals* are similar to those in the wetter savanna lands though fewer in number. There is considerable migration of animals (and nomad herders) to these areas during the wet season.

**Number 4 Type: Hot desert.** While discussing these African deserts we will survey deserts generally, together with desert scenery and the evolution of desert landforms.

## The Evolution of Desert Landforms

**1. Definition of a desert.** There are many differing definitions of the term "desert", but all include the idea of extreme aridity, where evaporation greatly exceeds rainfall. There is also the idea of an annual rainfall too low and too erratic or too markedly seasonal to enable the area to support permanent human occupation without the aid of irrigation.

**2. Causes.** No single cause will create a desert as extensive as the Sahara or Kalahari. The major reason is the latitudinal position between 15° and 25° north and south, for here is a zone of permanent high pressure where a continental air mass builds up with outpouring trade winds. These conditions give sunny and rainless weather. Other causes, which operate in local areas particularly, are (i) rain-shadow areas in the lee of high mountains; (ii) areas adjoining cold ocean currents as in the Kalahari; (iii) permanent off-shore winds.

**3. The desert climate** is characterised by (i) a low erratic rainfall coming mainly from scattered thunderstorms; (ii) great temperature variations, both daily and yearly; (iii) dews at night in sufficient quantity to be of some significance to plant life.

**4. Surface.** The desert surface is characterised by several different types of landform, each of which may occur over large areas, or all may be intermingled in quite small areas.

The principal weathering agents in hot dry climates are (i) the heat of the sun followed by the cooling at night; (ii) the wind, especially when it blows along large amounts of sand grains, which are harder than steel; (iii) the rushing torrents that come after thunderstorm rains have fallen on unvegetated ground.

(*a*) *Sun's heat.* The heating of large exposed rock surfaces causes them to expand and sets up considerable strains and stresses within the rock which weaken its structure. The sudden cooling from rapid radiation after sunset aids this breaking up of the firm bond between the rock crystals. After some time large and small sheets of rock split off and slide down to the base of the rock mass to collect as loose rock fragments known as *screes*. The process of peeling is known as *exfoliation*, and it is the major source of loose rock material in deserts.

(*b*) *Wind.* The deserts are areas of constant winds of moderate strength and these winds are for ever at work as they blow over the generally unprotected arid landscapes. The finest particles are lifted by the winds and carried for hundreds of miles, often beyond the limits of the desert. Here the aeolian (wind-borne) deposits build up to form areas of *loess soil* such as occur in North China, mid-west U.S.A., and central Argentina. The coarser grains are not so readily moved and they are rolled and bounced along the surface. Where local factors of topography and wind conditions check the movement, great sand dunes are built up.

In these sandy areas, known generally as *erg*, the dunes may take on many different patterns. A common one is the *barchan* type, which is crescent-shaped with its horns pointing down wind. Elsewhere the dunes may string out in long lines like railway embankments that often run roughly parallel for hundreds of miles; such ridges are called *seif*.

Apart from carrying away loose sand and dust, the wind also does some land sculpture. As it rushes the sand along close to the ground surface the hard grains polish and undercut soft rocks, and many fantastic rock pillars in deserts are wind-carved. In some desert areas the removal of the sand by wind leaves the surface covered with faceted and polished stones; such an area is called *reg*.

(*c*) *Torrents.* The most powerful erosional agent in deserts is running water. When rain does fall it mostly comes in torrential thunderstorm showers which can produce devastating effect on the loosely knit covering of the desert surface. Vast quantities of this loose material are swept out of the hills onto the adjoining plains and flats. Here they form immense *alluvial fans* at the mouths of the re-entrant gullies. In time the basins between hills may be completely filled with this loose material. In the mountains and hills where the rushing streams are confined by the landforms they rip out great canyons and deep watercourses called *wadis.* In time the water cuts down the ridges between these wadis and canyons to leave the landscape as a flattish rocky pavement on which stand occasional isolated hills that are the remnants of the mountain area. Such a pavement is called a *hamada* desert, and the isolated hills surrounded at their base with masses of scree material are called *inselbergs.*

In enclosed deserts such as the American Basin and Range Province (see Figure 58) or the Lake Chad area, inland drainage areas develop. These have many characteristic features. The streams running into them from the surrounding mountains finally die out in shallow lakes and swamps. After rain these swamps may become temporary lakes, but the extreme evaporation soon dries them up to salt-encrusted marshes. Such swamps are called *playas.* Where there is a large desert basin of this type ringed by mountains and containing many playas, the area is known as a *bolson.* In the true bolson the whole basin is being slowly filled by the alluvial fans built into it by the streams from the surrounding mountains.

Owing to the general absence of vegetation other than cacti and tough shrubs, the various landforms of desert areas stand out stark and bare without the softening effect of trees and grasses.

(*d*) *Cycle of erosion.* It is helpful to appreciate the cycle of erosion in desert lands.

(*i*) The early stages are marked by unfilled bolsons surrounded by angular hills and mountains. The playas in the bolson flats may even contain permanent water and the streams flowing to them have some semblance of permanency.

(*ii*) In the mature stage the mountains and hills have been worn down considerably, and along their bases stretch enormous alluvial fans to form a continuous piedmont plain. Out in the middle part of the bolson the fans from opposite sides almost meet. The hollows are filled with playas which are now salty swamps or vast salt-encrusted plains which the streams from the mountains reach only after exceptionally heavy rains.

(*iii*) The old-age stage is characterised by almost completely filled basins in which the remnants of the mountains stand as inselbergs (or mesas and buttes). Here and there larger mountain remnants stand out as rocky hamada. On the desert floor there are now considerable patches of erg, and the playas and streams have practically disappeared. There are now no wet mountain areas fringing the region, and the few rainstorms that do occur are quickly absorbed by the loose material (or *regolith*) covering the basin floor. Such areas have very little to offer man and are to be regarded as among the most difficult lands on earth for human settlement.

**5. Life in the deserts.** All deserts have much plant and animal life, even though they may offer little to attract the farmer or the grazier. All such life is specially adapted to withstand extreme aridity and heat.

(*a*) *Plants* are scattered over nearly all desert surfaces and show many ingenious devices to withstand aridity. Most species have large root systems to collect as much water as possible from the meagre rainfall. This accounts for the wide spacing of desert plants as they have much more growth under the ground than above it. Many plants have special water storing devices and many are protected by hairs, spines and thorns; the loss of a leaf full of water can be serious to a desert plant. Other plants have few leaves and all leaves are small. Many turn their edges to the sun during the heat of the day to prevent transpiration. Some common desert types in Africa are acacias, thorn bushes, bunch (or tuft) grasses and shrubs. Such vegetation is known as *xerophytic* (i.e., plants resistant to dry conditions and exhibiting many devices to limit transpiration).

After the occasional rainstorms a wealth of quick-growing and quickly dying plants spring up. These are the ephemeral herbs and grasses which are so important to the nomadic herding peoples using the deserts.

(*b*) *Animals*, like the plants, are adapted to withstand aridity. Lizards and reptiles are common, and many insects and birds manage to survive in the harsh environment. The camel is perhaps the best known of desert animals, but it cannot go for days without drinking unless carefully trained to do so.

(*c*) *Man* occupies and uses the deserts in three main ways. First, the oasis dwellers form small spots of dense agricultural settlement round the waterholes. The size of these varies from a few families to many thousands. Crops grown are cereals, stone fruits, citrus fruits and dates. A special variation of this type occurs where large-scale irrigation projects are developed in desert areas, as along the Lower Nile.

Secondly, groups of nomad herders move their flocks and herds from the adjoining semi-arid lands when the brief rainy season gives some fodder for their roving animals. Nomadic hunters like the Australian aborigines wander over the deserts at all times in search of game for food.

Thirdly, mining companies move in and establish modern towns and cities on wealthy mineral deposits. Some of these are the gold at Kalgoorlie, the silver-lead-zinc at Broken Hill, the petroleum of Arabia, Kuwait and Sinai, the nitrates and copper of the Atacama Desert and the boron of Death Valley, U.S.A.

Such invasions often have a profound effect on the lives of the native inhabitants. The oilfields of Arabia probably show this best, as they employ thousands of former nomads as workers, and they are paying the ruler of the country tens of millions of pounds yearly in royalties. In one decade much of Arabia has advanced from the primitive herding stage of civilisation to the modern mechanical age.

**Number 5 Type: Mediterranean or warm temperate.** This type and its characteristic vegetation (Number 8 type on Figure 18) occur in the Barbary States and Cape Colony. This very characteristic transitional climate has warm to hot summers (when it approximates to the adjoining

deserts) and mild wet winters (when it resembles the nearby wetter lands). The rainfall of 25 to 50 inches a year is moderate and comes in scattered rainstorms rather than in a continuous drizzle. Warm sunshine is accordingly a feature of the winter climate and makes these lands attractive holiday resorts for people from the colder and wetter northern European countries.

*Vegetation* consists of forests of oak and cedar on the wetter mountain slopes and maquis or chaparral elsewhere. Both maquis and chaparral are stunted evergreen trees and shrubs with sclerophyllous leaves (from the Greek words *phyllon*, a leaf and *skleron*, meaning hard or tough) and rough bark. In Corsica and southern France the maquis was used as a cover by outlaws during the nineteenth century; and the name was adopted by the French resistance movement during the German occupation of World War II. The grasses of this region are rather tough except during the wet winter period, when many ephemeral herbage plants appear.

**Number 6 Type: Humid sub-tropical or Natal type.** This modification of the nearby Mediterranean type occurs along the Natal coastal lowland. As well as the cyclonic winter rains, it receives summer rains from the south-east trades, so that its total of 30 inches to 60 inches is fairly evenly distributed throughout the year.

Temperatures are mild to warm throughout the year and are inclined to be unpleasant in mid-summer when high humidities prevail.

*Vegetation* (Number 10 on Figure 18) is essentially sclerophyllous forest and woodland on the coastal valley plains and lower foothills of the Drakensberg. Above 2000 feet it changes to grassland and thorn bush and at 8000 feet to conifers.

**Number 7 Type: Mountain climates** are found mainly on the higher parts of the Drakensberg, the central highlands north of Lake Tanganyika, on Kilimanjaro, Elgon, Kenya mountains and in the higher parts of Abyssinia.

The main character is the zoning of climate with elevation and the corresponding zoning of vegetation types. This type is dealt with more fully in the discussion on the Peruvian Andes in the section on South America, (Chapter IX).

## Climatic Traverse of Africa

Figure 20 is a summary of African climates in the form of three sets of rainfall graphs traversing the continent from north to south on the western side, in the centre and on the eastern side. The graphs should be studied in conjunction with the map of climatic regions (Figure 17). In each case the short notes alongside the rainfall graphs include the Koeppen symbol for the climate of the town graphed and an indication of the

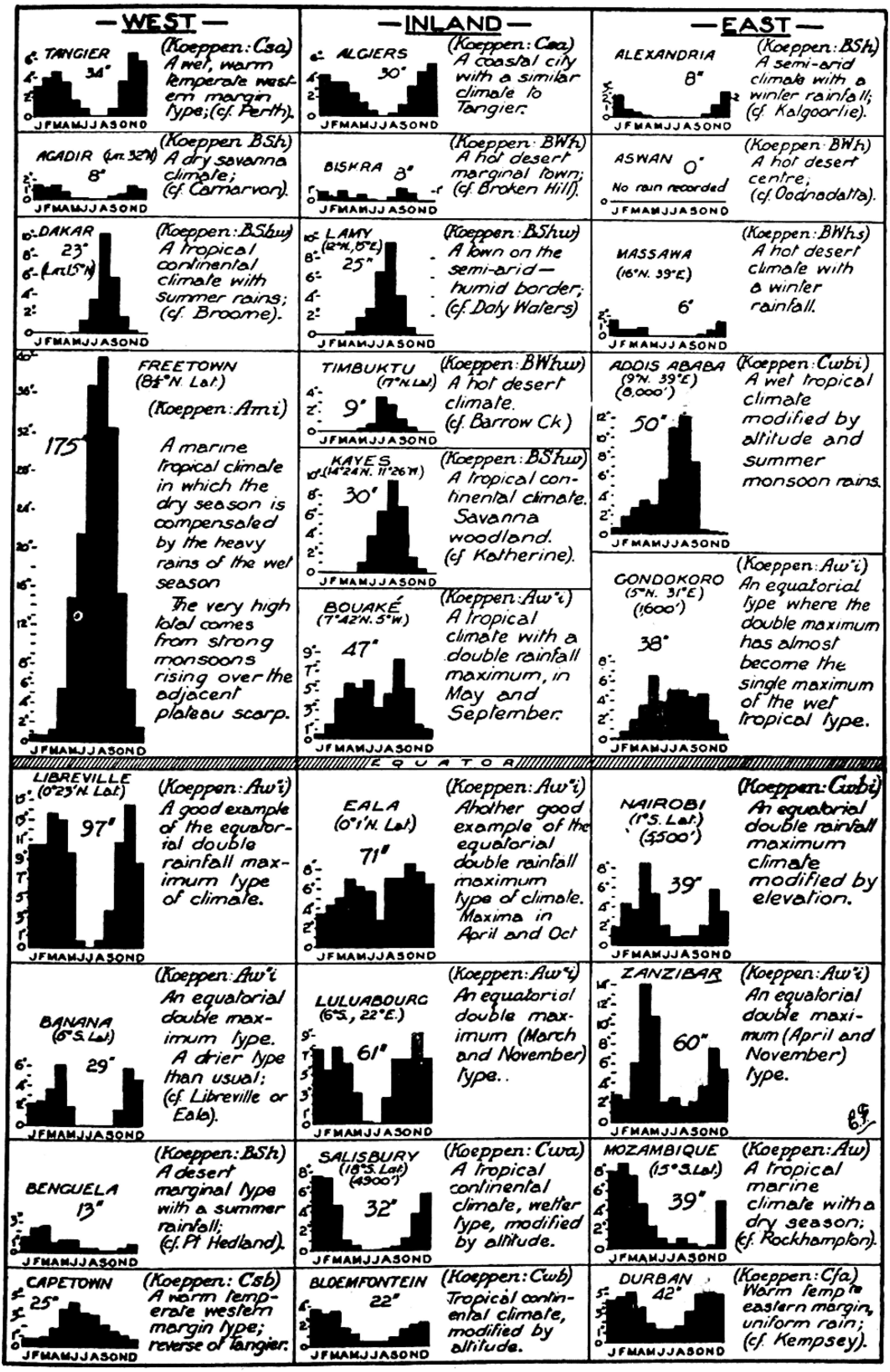


FIG. 20. *Graphs to illustrate climatic traverses across the west, centre and east of Africa from south to north.*

temperature conditions. Where possible, towns with similar conditions in Australia have been included for comparison.

The Koeppen symbols were devised by a German botanist in his monumental work on world climates as a means of briefly summarising the rainfall, temperature and other special climatic conditions of any place. For a fuller discussion on their meaning and how they were obtained you should go to your library and read the appropriate section in Davis, *Earth and Man*; Finch and Trewartha, *Elements of Geography*; or Preston James, *A Geography of Man.*

To help summarise the climatic knowledge you should draw a map of Africa and mark on it the climatic regions as shown in Figure 17. Then locate and mark each of the places used in Figure 20. You will then appreciate the value of the graphs in illustrating the pattern of climates in Africa.

As well as noting rainfall changes from north to south, these graphs may be used to study changes from east to west. Each set of three towns is approximately in the same latitude, and comparison of the rainfalls makes an interesting study.

Finally, these graphs should be taken as being a summary of much of the work on climate. They should not be studied by themselves but should be related to all the earlier work on climate in this chapter.

## EXERCISES

1. Vocabulary words and phrases: high pressure, low pressure, air masses, convectional rains, orographical rains, rain shadow, cold wall, doldrums, trade winds, monsoons, savanna, epiphyte, hygrophyte, xerophyte, screes, exfoliation, loess, alluvial fan, wadi, playas, bolson, ephemeral vegetation, sclerophyllous, maquis.

2. Discuss the manner in which the movement of the heat equator and pressure belts affects the climate of African lands lying between 10° N. and 20° N. and between 30° N. and 40° N. latitudes.

3. Describe and account for the changes in climate met with on a journey along the west coast of Africa from Cape Town to Tangier.

4. Compare climatically the east and west coastal areas of Africa between 10° S. and 25° S. latitudes. Relate any climatic differences noted to the vegetation of these regions.

5. Write a description of the erosional processes and the resultant landforms of desert areas.

6. Describe the general sequence of vegetation zones on the west and east sides of Africa, and account for any differences you notice.

7. Describe the physical conditions characteristic of the following: rain forest, maquis, savanna woodland, desert, acacia scrubland.

8. Compare the grasslands and their animal inhabitants of Africa and northern Australia.

9. Discuss the climates of Kenya and Uganda as a factor in their possible economic development and compare their climate generally with that of Nigeria.

# CHAPTER III

# AFRICAN SOILS

Soils are to be regarded as a product of development from the original rock mantle of the earth. These evolutionary soil-forming processes are very slow; but they have been in operation for so long that the greater part of the earth's surface is now covered with soil of some kind. At the same time as the weathering agents have been breaking down the rocks into earth minerals (not to be confused with metallic mineral ores) the organic remains of plants have been added to the soil in the form of humus, and countless bacteria have developed in it to give it life and help make it life-giving.

## General Notes on Soils

**1. Definition.** A soil may be defined as a mixture of broken-down rock material mixed with humus and modified by the action of bacteria, water and air. It is the unconsolidated covering of the earth's surface in which plant life grows.

The fertility of a soil depends broadly on several factors, the most important of which are:

(*i*) The presence of critical soil elements in a soluble form. These elements are of two kinds (*a*) major, such as iron, sulphur, calcium, nitrogen, potassium and phosphorus; and (*b*) minor, or trace elements, such as copper, manganese, boron and molybdenum.

(*ii*) Depth and proper drainage. Depth is necessary to allow sufficient room for root development, while drainage removes excess water and saline minerals.

(*iii*) Texture, which deals with the size of the particles forming the soil. These vary from coarse grains about one millimetre in diameter in sandy soils to minute particles with a diameter of less than 1/500 millimetre in clays. Generally, a good agricultural soil contains a variety of particles mingled together.

(*iv*) Structure, which refers to the arrangement of the soil particles. In a good soil the particles are arranged in groups or granules which allow for pore spaces between them for the passage of air and moisture through the soil. Such a structure is called *flocculated*, and flocculation is a feature of all rich agricultural soils. It may be destroyed by incorrect farming and maintained by proper agricultural methods, which include crop rotation, the growth of legumes, and the regular ploughing of green humus into the soil.

**2. Soil classification.** There are various methods of classifying and describing soils. One very useful method is to use the manner of formation of the soil. This gives two main groups:

(*a*) *Residual soils*, which have formed in the position where they now are found; i.e., they have resulted from the gradual disintegration and chemical and structural alteration of the underlying parent rock to which they are still directly related. This soil group includes most of the world's soils.

(*b*) *Transported soils*, which have been carried to their present position by the action of ice (morainic soils and tillites); water (alluvial soils); wind aeolian soils (of which loess is a common example); and the sea (raised sea beaches and off-shore coastal plains).

The more accurate method of soil classification examines the profile (or section seen in a hole or cutting), noting the physical and chemical properties of the various layers seen. Such examinations of residual soils show them to have a generally common profile in which three horizons (or levels) are distinguishable. These are shown in the sketch Figure 21(b) and are three in number:—

(*i*) *The A-horizon* (or surface soil) which contains most of the humus and plant foods and has a colour that varies with the soil type and climate.

(*ii*) *The B-horizon* (or subsoil) which is usually clayey in form and often contains a layer of soluble minerals deposited after removal from the A-horizon.

(*iii*) *The C-horizon* (or disintegrating parent rock) which is directly related to the A- and B-horizons in residual soils but may be unrelated in transported soils.

**3. Soil moisture.** The movement of moisture through the soil has a marked effect on the distribution of soil minerals. Such movement is related to the climate and the distribution and amount of rainfall. The broadly generalised movement of soil moisture under the two extremes of very moist and very dry climates is sketched in Figure 21(b).

Under constantly wet conditions there is a steady downward movement of soil moisture through the A- and B-horizons. This moisture *leaches* the upper soil layers by removing soluble minerals to deposit them deep in the B-horizon. Such leached soils usually have an A-horizon consisting of insoluble silicates of aluminium or iron or consist of practically pure sand. Desert conditions, where evaporation greatly exceeds rainfall, result in an upward movement of soil moisture by capillarity and the deposition of lime, gypsum and salt in excessive amounts in the A-horizon.

Soils formed in regions intermediate between wet and very dry are of an intermediate type. These will be discussed at greater length as they are met with in other parts of the world.

Where leaching has occurred to a certain degree the surface soils tend to be acid in character and to contain high percentages of compounds of iron and aluminium. Such soils are often grouped together as *pedalfers* (*al* = aluminium; *fer* = ferrous or iron). Soils of dry climates tend to be neutral or alkaline in character and to contain high percentages of calcium salts in their A-horizons. They are grouped and called *pedocals* (*cal* = calcium salts). (See key to Figure 21 (a).)

## Brief Survey of African Soils

The two major groups of wet-climate and dry-climate soils are well represented in Africa, and there are several transitional types between the wet and dry areas in regions which have marked seasonal rainfall.

Practically all equatorial and wetter tropical lands are occupied by red and yellow soils of differing type (the colours come essentially from iron salts).

*Laterites,* which consist of a hard crustal layer of oxides of iron overlying a wet mass of clayey material compounded mainly of hydrous silicates of alumina, occupy only a small portion of the tropical lands, and are now believed to be largely fossil soils from a previous era. Laterites occur only in tropical lands of high annual rainfall usually with alternately wet and dry seasons. Their occurrence elsewhere as in southwest Western Australia and parts of New South Wales can be taken as indicative of long term climatic changes there.

All other tropical soils in areas of moderate to heavy rainfall are leached to some extent and are often known as "lateritic" in character.

*Tropical and sub-tropical red and yellow earths* on Figure 21(a) are examples of this type. Much of these red and yellow earths in the wetter tropical lands is covered with forest. Here the organic content of the A-horizon is being constantly renewed from decaying forest litter but little of it remains under the constant heat and moisture. When the forest is cleared for agriculture there is no further renewal of organic content and the soil rapidly loses what little fertility it had.

Bordering the tropical red and yellow soils in areas of lower and more marked seasonal rainfall where grasslands occur are belts and patches of *tropical black soils* (tropical chernozems) and *tropical chestnut soils* (brown steppe soils). In them the humus and plant mineral content is much higher, since the low seasonal rainfall does not leach the soil, and the long dry season allows for a constant replenishment of the humus from the decaying grass of the wet season. These soils are normally very fertile, but agriculture is mainly found where water is available for irrigation (e.g., the Gezira or inner Niger Delta). Elsewhere there is a scattered growth of crops during the short rainy season.

*The desert soils* vary from pure sand to clay flats and rocky outcrops. Their high content of alkaline minerals renders them somewhat infertile, though the addition of irrigation water (as around oases) quickly rearranges the mineral content and makes them normally fertile.

*The volcanic soils* of Abyssinia and Kenya are deep and rich and where farmed yield good crops.

**Use by man.** As noted above, much of the tropical red and yellow soil country is inhabited by shifting cultivators or primitive sedentary agriculturists who also herd cattle in many instances.

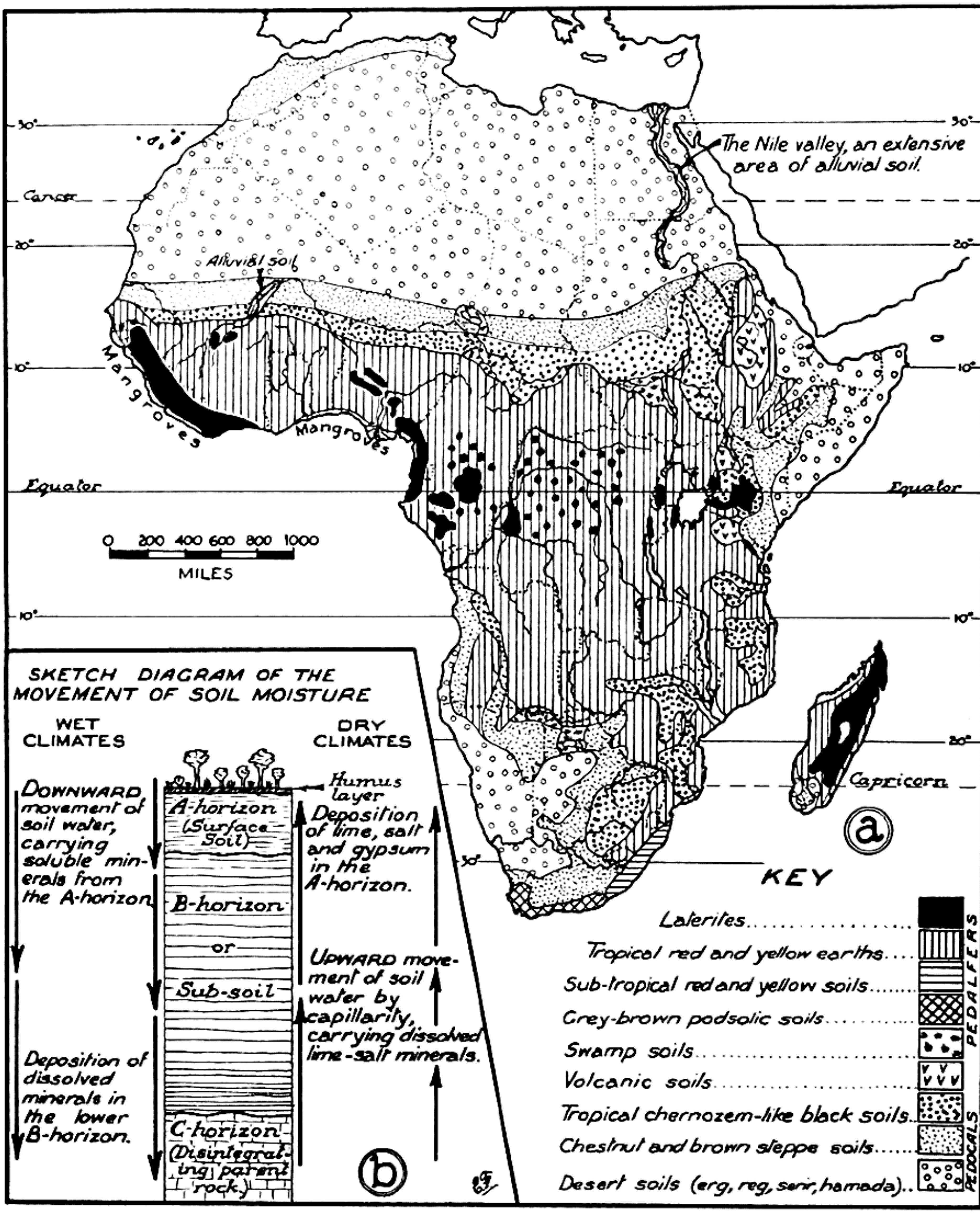


FIG. 21. (*a*) *Generalised soil map of Africa.* (*b*) *Inset sketch to show the movement of soil moisture in wet and dry climates.*

Both of these cultivation types use either a wooden plough which merely disturbs the surface soil without turning it over, or a hoe which only digs up an inch or two of soil. Where mechanical traction and the steel plough or disc-cultivator have been used on these red and yellow soils (as with the disastrous East African Ground Nut Scheme) the effect has been little short of catastrophic. Rapid loss of soil humus when exposed to the air, gullying and sheet erosion and general loss of soil fertility have resulted. It would appear that the old and primitive native way of farming is the one most suited to the soils and the climate. Any development and advancement will have to be based on this form of agriculture rather than on the European form which was evolved in a cool and moist climate vastly different from that of Africa.

## EXERCISES

1. **Vocabulary words and phrases:** soil texture, soil structure, flocculated, humus, aeolian soils, tillite, pedocal, pedalfer, leaching, laterite.

2. Soils have been described as the product of the interaction of climate and vegetation. See if you can establish any such relationship among the soils, climate and vegetation of the African continent.

One of the best ways to do this (and incidentally any other type of distributional comparisons) is to draw a soils map (as in Figure 21 (a) ) and colour it heavily. On one traced outline on tracing paper mark in the climatic regions and on another the vegetation regions. Now superimpose the traced outlines over the original soils map. Note the areas that generally correspond and also those that do not correspond. The latter are important as the differences can be quite significant when discussing general relationships among natural features of a continent.

3. Examine a fresh road cutting, brickworks pit or railway cutting and note the soil horizons. Draw a sketch profile to show the thicknesses of the various horizons and write marginal notes on their physical character.

4. Explain the chief factors determining the natural fertility of soils.

5. Go to the library and read the chapters on soils in Davis: *Earth and Man* (both the chapter and the appendix); Finch and Trewartha: *Elements of Geography*; Kendall, Glendinning and Macfadden: *Introduction to Geography*; or White and Renner: *Human Geography*; or any other general geography which has a chapter on soils.

While you are not expected to become a soil scientist it is important for you to know the general character and farming potential of the main soils of the world.

6. The C.S.I.R.O. has an excellent *Bulletin* on Australian soils. Try to get one for the school library. Also, the newly published *Atlas of Australian Resources* has a good (though rather detailed) map of Australian soils and a good brief survey of these soils. You should get this atlas for your school library.

7. Using the factors of landforms, climate and soils discuss the general possibilities of (a) the Congo Basin; (b) Northern Nigeria; and (c) the Sudan for economic development.

8. Why are most soils of inter-tropical lands poor and how does this affect the food supply of many of the native peoples of these lands.

9. Discuss with reference to specific areas (a) the reasons for the occurrence of soil erosion, and (b) the means and economic importance of remedying such erosion.

# CHAPTER IV

# AFRICAN MINERALS

## General Survey

Many kinds of minerals occur widely scattered throughout Africa, as the huge areas of the continent composed of Pre-Cambrian and early Palaeozoic rocks have been favourable to the accumulation of mineral lodes and ore bodies. In addition, the laterites of the tropics and certain areas of leached red and yellow soils are sufficiently rich in iron and aluminium to make their quarrying and export commercially worth while. As yet this potential source of two basic industrial metals has barely been touched.

To date only one coalfield of any size has been discovered, the Transvaal-Natal field of the south-east, where bituminous coal of good quality is mined in several places over an area of some 10,000 square miles. Elsewhere the shortage of fuel minerals tends to give an exaggerated local importance to any small coalfields that do occur. Again, oil has so far been found only in the extreme north-east, in Egypt, though there are geological forms in the rock structure that indicate a possible extension of the Arabian oilfields into Somaliland and Abyssinia.

Figure 22 indicates the general pattern of developed mineral mining in Africa, and on it the various areas have been grouped to help in describing them. There are both major concentrations of mineral wealth and significant absences of minerals to be noted on this map. The major concentrations occur in the Atlas Mountains, Gold Coast and Sierra Leone, Katanga and Northern Rhodesia and South Africa. Notable deficiencies in practically all minerals occur along the eastern side of the continent and throughout the Saharan region.

The following table lists minerals for which the African continent is of world importance. The percentages are calculated on the average production during 1949, 1950 and 1951. In each case the percentage is of the world total during the period under review.

African Minerals as Percentage of World Production

| | | | |
|---|---|---|---|
| Diamonds | 96 per cent | Copper | 19 per cent |
| Columbium | 95 ,, ,, | Asbestos | 18 ,, ,, |
| Cobalt | 83 ,, ,, | Tin ore | 14 ,, ,, |
| Gold | 55 ,, ,, | Vanadium | 9 ,, ,, |
| Chrome ore | 42 ,, ,, | Coal | 5 ,, ,, |
| Phosphates | 31 ,, ,, | Lead-Zinc | 5 ,, ,, |
| Manganese | 28 ,, ,, | Uranium | † |
| Platinum | 24 ,, ,, | Radium | † |

† Leading producer.

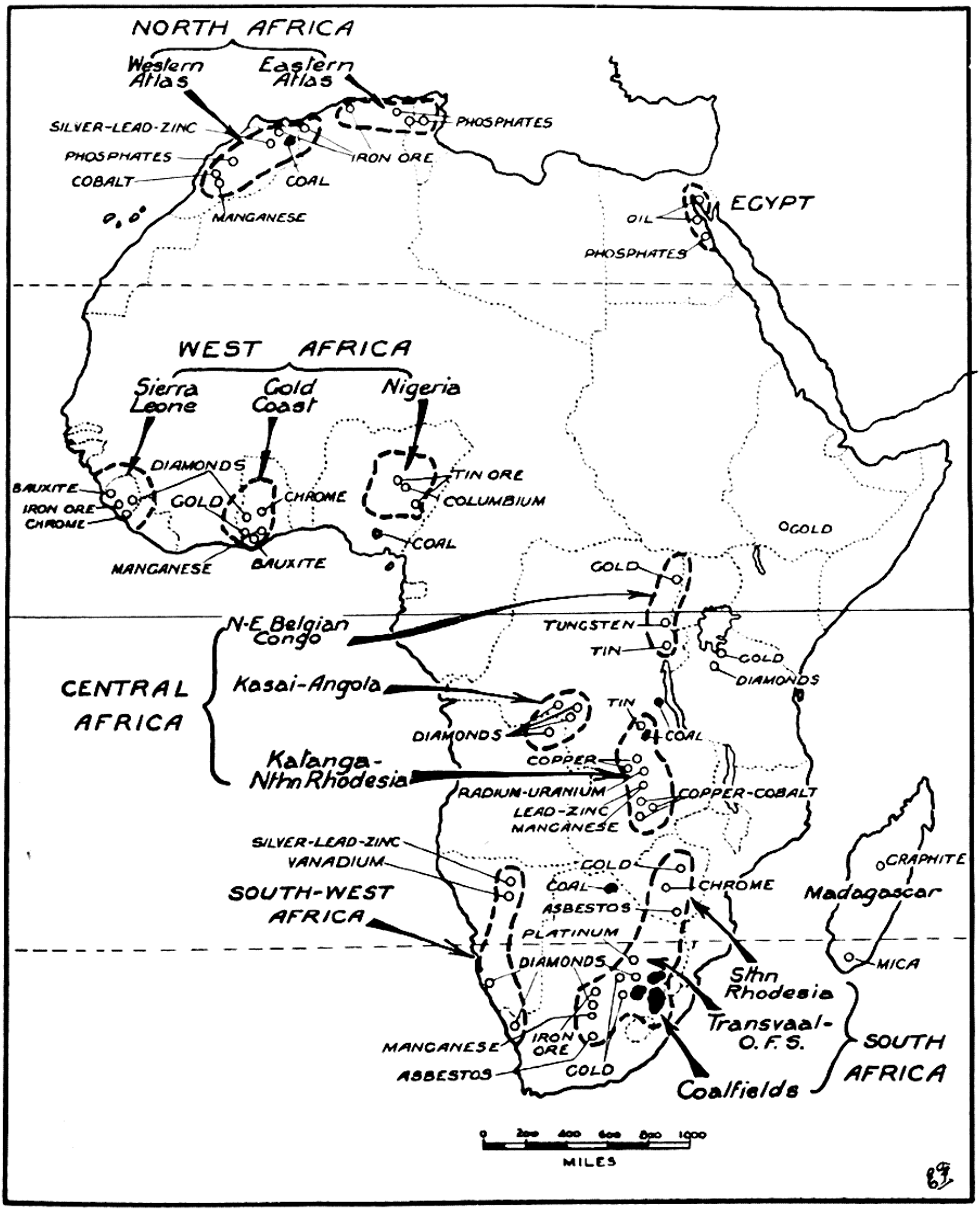


FIG. 22. *The distribution of the major mineral regions and mining areas in Africa.*

## Brief Survey of Main Areas (Figure 21)

**1. North African areas.** Evidences of many different minerals have been reported from the Atlas Mountains region, but only a few of these have so far been exploited on a large commercial scale. At present the area contributes nearly one-third of the world's natural phosphates. These are quarried and exported to western European countries for the manu-

facture of fertilisers, which are widely used in the intensively farmed regions there. Large iron ore deposits are worked in Algeria and Morocco, and the ore is exported to England, the United States and Germany. Other minerals produced include cobalt, manganese ore and lead-zinc ore in Morocco and small amounts of anthracite coal near Oran in Algeria.

**2. West African areas.** The principal areas here are in the Gold Coast and Sierra Leone. The Gold Coast produces considerable amounts of manganese ore, bauxite and chrome ore. These are exported to England and western Europe. It is also noted for its output of industrial diamonds, while gold is still an important mineral with an output equal to roughly 75 per cent of Australia's. The main minerals produced in Sierra Leone are iron ore (which is exported to England), chrome ore, bauxite, and small amounts of industrial diamonds.

Nigeria has widespread tin-columbium deposits, which are worked mainly by crude hand methods by the natives. It also has a deposit of black coal on the Lower Niger at Enugu, which is mined for use on the local railways.

**3. Central Africa.** Several areas occur here with the Katanga-Northern Rhodesian one being outstanding. This area is discussed separately in Section 2 on page 45.

The Kasai-Angola diamond fields are the world's most important with 66 per cent of the world's output, but they produce only four per cent of the gem stones; most of these come from South Africa.

The north-east Belgian Congo area is as yet too isolated to be a big producer of the minerals it contains, but their presence is important as an indication of future possibilities.

The small coalfields in the central African region are not of good quality but are locally significant for use on railways, in electric power stations and in smelting metal ores. Most of the coal used in this area comes from Wankie (south of the Zambesi River).

**4. South-west Africa.** This desert and semi-desert area resembles the Broken Hill area in New South Wales as the presence of minerals has been the main factor in opening up the country. The northern portion produces lead-zinc, copper, beryllium and vanadium, while the extremely arid south-west Namaqualand is noted for high-quality gem-stone diamonds.

**5. South Africa.** This is the most important mining area in Africa, as it contains the world's greatest goldfields in the Rand, Orange Free State and Southern Rhodesia as well as the major coalfield of the African continent and important centres for the production of asbestos, chrome ore, manganese, iron ore, diamonds and platinum. The minerals of this region are dealt with more fully in Section 3(a) on the Rand and in the later section on South Africa (see Chapter VII, Section 1).

**6. Madagascar.** Though many minerals have been reported from this island very little has been done to develop them. At present small amounts of gold are mined and there is a moderate export of graphite and mica.

## Detailed Study of Selected Areas

**1. The Rand goldfield.** The Witwatersrand ("Ridge of White Waters") area of Transvaal is an important watershed from the northern slopes which the Crocodile River and its tributaries drain to the Limpopo and the Indian Ocean, while the Klip River drains the southern side to the Vaal and the Atlantic.

The main Rand goldfield varies from two to seven miles wide for most of its length, widening to over 18 miles at the eastern end. It extends some 60 miles from east to west with the city of Johannesburg stretching across its centre.

Geologically the area is composed of great beds of Pre-Cambrian conglomerates mingled with other sedimentary rocks in a series five miles thick resting on underlying granites. The conglomerate beds are called "reefs" and they outcrop at the surface in places along the Witwatersrand watershed. They dip sharply (usually at 30 degrees to 40 degrees) southward beneath a cover of younger rocks which are barren of gold but contain some scattered coal beds (see Figure 23). Practically all the massive conglomerate reefs contain some gold, but the most important economically are narrow bands known as the Main Reef and Main Reef

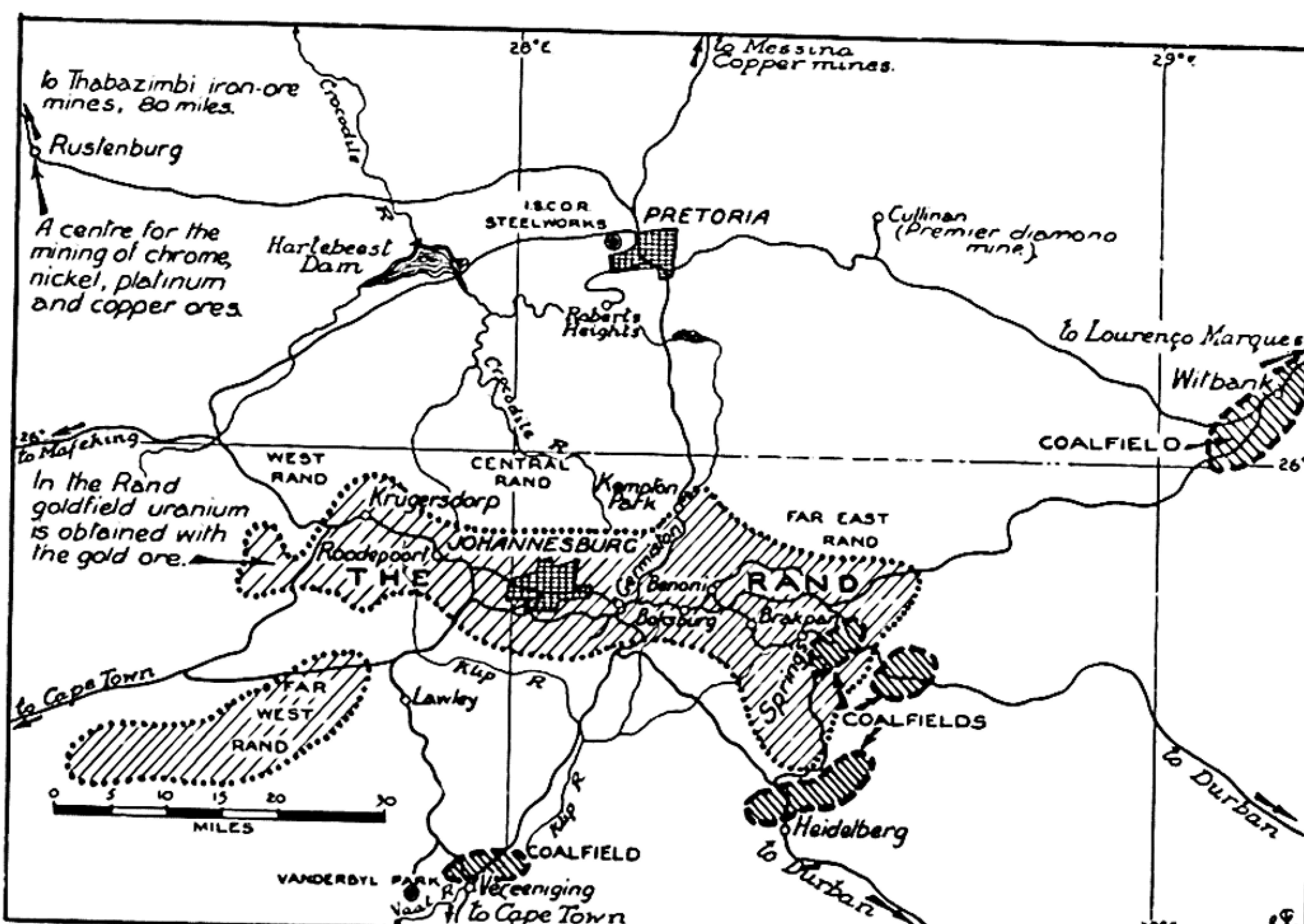


FIG. 23. *Rand goldfields and surrounding mining and manufacturing districts.*

Leader. These have been mined for 70 years from the surface outcrops down to depths of over 9300 feet.

(*a*) *Development.* The Rand fields were discovered in 1884, and opened up by numerous mining companies between 1886 and 1889. The early development was on the Central Rand (see Figure 23) and in 1888 there were 43 mining companies operating in a line running for 15 miles with Johannesburg in the centre. The West Rand was opened up between 1898 and 1912 and the Far Eastern Rand between 1912 and 1923.

As the shallower ores were exhausted, many small companies closed down and the industry passed into the control of large concerns. These had a large capital to outlay on deep mining operations and the costly plant capable of treating the lower grade ores which occurred at greater depths.

After 1938 it was found that the ore-bearing conglomerates extended west and south of the old Rand fields and new mines were opened up in what is called the Far West Rand area (see Figure 23). The richest mine in the whole area (West Driefontein) and the largest gold producing mine (Blyvooruitzicht) are both in this field. New rich finds round Klerksdorp, on the Vaal River, and Odendaalsrus, 85 miles north of Bloemfontein in the Orange Free State, indicate a possible extension of the Rand conglomerates over a much wider area than was originally believed.

The development of the Rand goldfield was made possible by abundant nearby supplies of coal and by a plentiful supply of water both on the surface and from underground workings (the latter can be used in the ore treatment plants). At present one of the great problems in the mining is the ventilation of the deeper workings and the constant pumping of water from the mines. These factors have limited development beyond present depths.

A future problem lies in obtaining sufficient fresh surface water to allow for increasing urban development in the Johannesburg conurbation and for rapidly expanding industry throughout the whole area between Pretoria and Vereeniging.

(*b*) *Other mining activities.* Though gold mining dominates the activities of this sub-region there are several other very important mining activities. Among these may be noted:

(*i*) Diamond mining at the Premier mine at Cullinan (see Figure 23). For many years this mine rivalled the Rand as a world-famous centre and in 1905 produced the Cullinan stone, the world's largest diamond. Production today is limited to underground workings at the bottom of the enormous hole excavated by open-cut methods prior to 1932.

(*ii*) Coal mining is carried on in the Witbank, Springs, Heidelberg and Vereeniging areas (see Figure 23). Except for the Witbank coal, which is suitable for making blast furnace coke, most of these fields produce a rather low grade bituminous coal. This is used by the railways and in

several large thermal-electric power stations that supply the mines and cities with power.

(*iii*) Iron ore for the steelworks at Pretoria and Vanderbyl Park is mined at Thabazimbi about 80 miles north of Rustenberg. Approximately two million tons a year are used by the two smelting plants.

(*iv*) Rustenberg district (60 miles west of Pretoria) is an important mining centre for platinum, chrome ore, and nickel-copper ores.

(*c*) *Processing and manufacturing industries.* Along with the development of mining there grew up many local processing industries to supply the needs of the city peoples and mining industries of the area. Thus, food and clothing factories developed together with machine shops for making and repairing mining equipment.

In 1920 the Rand refinery was established by the various mining companies in order to refine all gold from the area. From smelting plants it receives bullion containing 88 per cent gold, nine per cent silver and three per cent other base metals. It refines this and sends out gold in bars of 400 oz., which contain 995 parts gold and 4.5 parts silver.

In 1922 the Electric Supply Commission (ESCOM) was established and empowered to plan for complete electric supplies to the whole Rand region. This has been done by setting up an interlocking electric grid system fed by several large thermal power plants.

Steel production began in 1934, when the South African Iron and Steel Industrial Corporation Limited (ISCOR) plant opened at Pretoria. In 1944 a new plant was started on the open veldt at Vanderbyl Park near Vereeniging. The two plants in 1955 turned out over a million tons of finished steel products and an expansion of 50 per cent is planned for the near future.

The most recent industrial development in the Rand area has been the setting up of a series of plants at gold mines to extract uranium from the gold ores. It has long been known that the Rand ores contain small amounts of uranium, but until recently it had no commercial value. With the development of atomic power it will become an important by-product of this fabulous mineral area.

**2. The Katanga-Northern Rhodesian mineral area.** This rich mineral zone affords an excellent example of two contrasting geographical factors. First, it shows the difficulty of opening up isolated mineral areas without satisfactory means of communication. The presence of vast reserves of copper in this area was known long before the first attempt to exploit them in 1906; but it was not until a railway was pushed into the area from the south in 1910 that mining began in earnest.

Secondly, it illustrates the importance of rich mineral bodies in attracting notice to an isolated area and in bringing about its development.

The Katanga area supplied native peoples with copper for ornaments and utensils for many centuries. It was also certainly known to the Arab

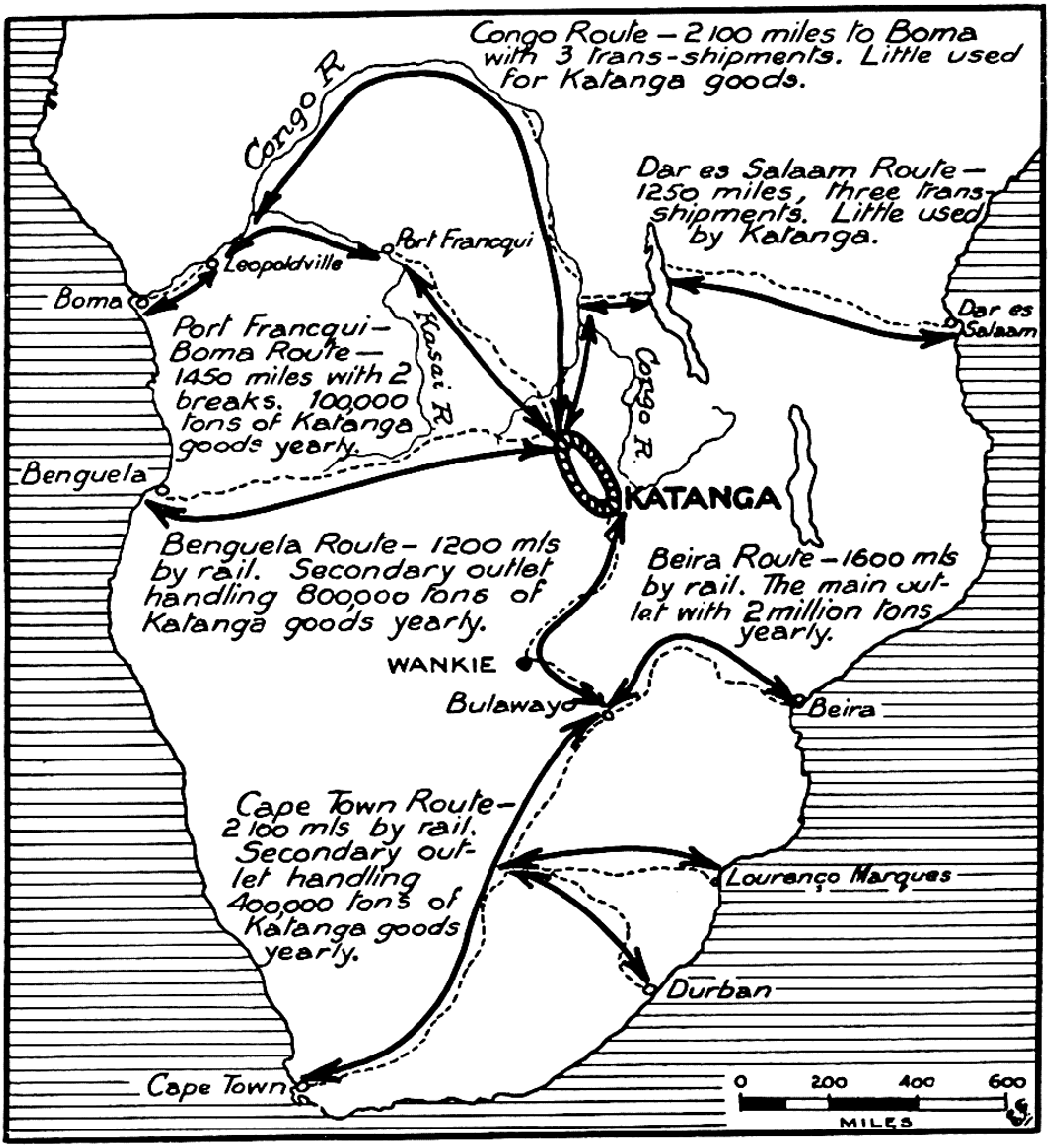


Fig. 24. *Position of the Katanga mining area and its route connexions with surrounding coastlands.*

slave traders who drove their human merchandise along the Angola watershed to the great slave port at Benguela (see Figure 24). Copper was of little value to European peoples until the age of electricity in the twentieth century made it a much sought after metal. Katanga and Northern Rhodesia then attracted the attention of the large-scale mining companies. Because of the long haulage over the railway from the south, development was slow at first. Also the era of ore-field smelting did not commence until after 1920, and only the richest ores could be transported over the 1600 miles to Beira or the 2100 miles to Cape Town.

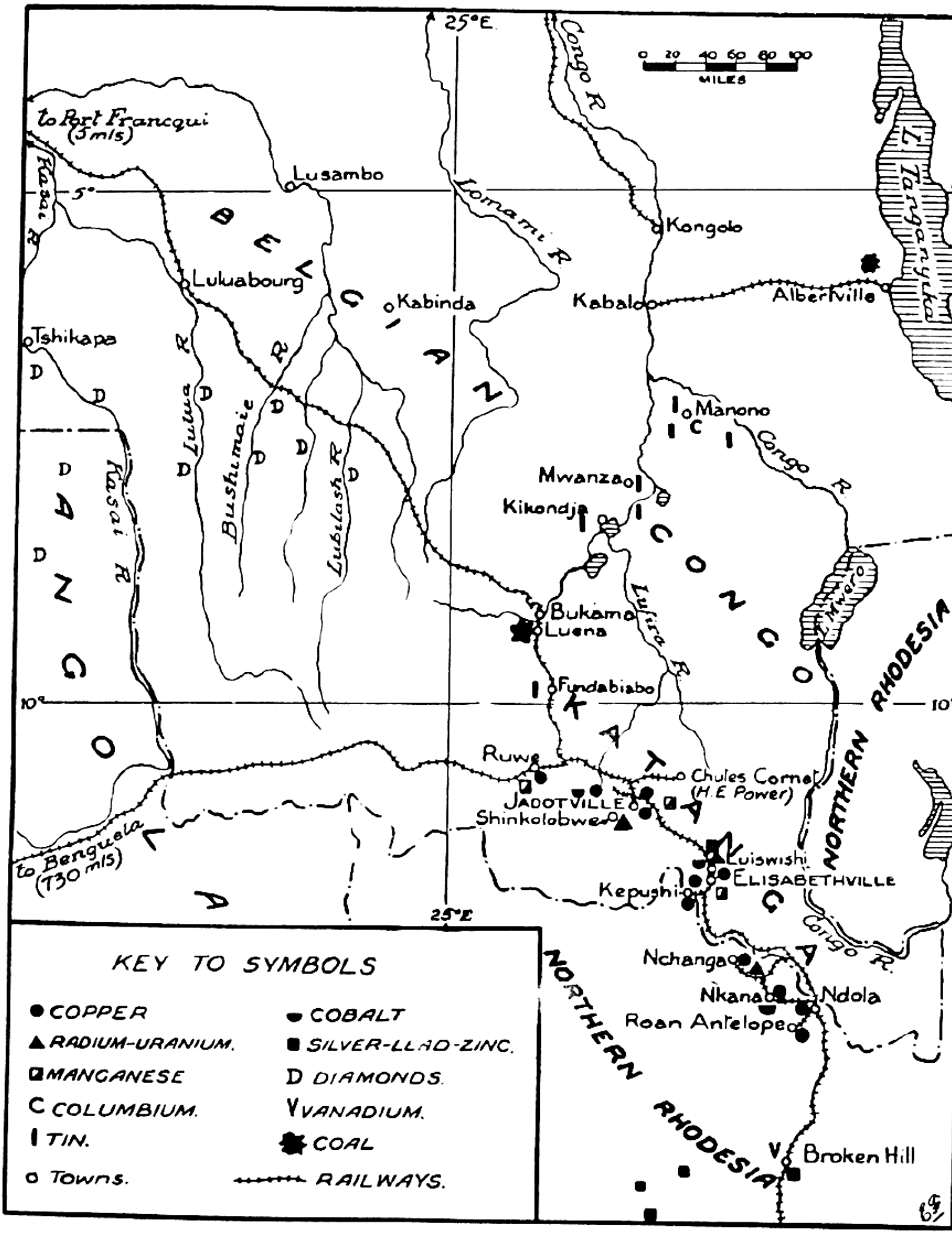


FIG. 25. *Detailed map of the Katanga-Northern Rhodesian mineral and mining area.*

*Development.* The introduction of ore-field smelting of the copper ores during the 1920s by using coal from Wankie (see Figure 24) was the first step in increasing production. It enabled poorer quality ores to be mined and treated before being exported. Further expansion followed rapidly when radium ore, tin ore, silver-lead-zinc ore and cobalt ore were

found in the same area (see Figure 25). In 1931 the rail link to Benguela was completed and it soon became an important outlet (and inlet) for the Katanga. The line to Port Francqui, opened in 1928, did not fulfil expectations as an outlet because of the changes in transport between the terminal and the sea (see Figure 24).

As Figure 25 shows, the area today is a highly developed mining district, with many important mining towns in both Katanga and Northern Rhodesia. These towns are well laid out and the treatment plants are modern and efficient. Electric power is supplied from thermal power stations using Bukama coal and from a hydro-electric power station at Chutes Corner.

Labour is recruited from all surrounding districts and the native workers are housed in clean airy huts. Sanitation, health, education and hospital treatment are all on modern lines. The principal centres are Elizabethville and Jadotville in the Belgian Congo and Roan Antelope, Ndola and Nchanga in Northern Rhodesia.

An interesting complementary development in the area has been the growth of commercial farming to supply the needs of the large working population in the mines, treatment plants and towns. Thus, in the heart of Africa we find an island of modern industrial development and commercial farming in an area where simple subsistence agriculture is the only other activity.

## EXERCISES

1. **Vocabulary words and phrases:** conglomerate, conurbation, bituminous coal, bullion, base metals. Find important uses of the following: columbium, cobalt, industrial diamonds, beryllium, chromium, manganese.

2. Discuss the significance of minerals in the opening up and development of Africa south of the Equator.

3. Using *either* the Rand goldfield *or* the Katanga mineral belt as an example, discuss the importance of rich mineral deposits in leading to the development of isolated or difficult areas.

4. Describe the evolution of the Transvaal industrial area. In your answer explain why such an area grew up in the heart of southern Africa.

5. Examine the proposed Ajena dam and H-E power station in the Gold Coast and estimate its possible importance to the expansion of mining and metal refining in that country.

6. Discuss the possible form of future development of mining and mineral refining in the various main mineral regions marked on Figure 22. In this discussion you will need to assess the significance of the absence of mineral fuels in Africa; and, at the same time, try to estimate future expansion in relation to the enormous potential of H-E power and apparently large resources of atomic fuels.

7. What is meant by ore-field smelting? What is its significance in the mining of low-grade ores?

8. Why has no significant industrial development taken place in West Africa?

# CHAPTER V

# PEOPLES OF AFRICA

## Population Density

**1. General features.** Figure 26 is a summary of the present known information regarding population density in Africa. When studying this map, it must be remembered that an official census has been taken only in Egypt, Morocco, Tunisia, Algeria, Sierra Leone, the Portuguese possessions, Nyasaland, South Africa, Kenya and Uganda. Elsewhere, and this includes most of Negro Africa, much of the information is based on guesswork, which, as the recent census in Uganda and Kenya proved, can be as much as 20 per cent wrong. Despite this drawback of patchy information, the map serves to illustrate several interesting points.

First, the average density for the whole continent is about 18 persons per square mile (based on *United Nations Year Book*, 1954 edition) compared with 46 for the world as a whole. If we make allowance for deserts, rugged mountains and water bodies in Africa, its average density rises to about 30 per square mile, which is still well below world average figures and far below the average for Europe, excluding U.S.S.R., where the figure is 210 per square mile or even the United States, where the average figure is 52 per square mile.

Secondly, despite its enormous area of desert lands, it is wrong to think of Africa as a continent of vast open spaces with few people in them. There are great contrasts in density to be noted. In the Nile Valley section of Egypt the population density averages more than 1200 per square mile, while southern Nigeria has areas with more than 300 persons to the square mile. The coastal lowlands of the Algeria-Tunisian area average about 150 per square mile and the Victoria Nyanza uplands (Ruanda-Urundi and southern Uganda) upwards of 200 per square mile in many parts. There are also dense patches with more than 125 persons per square mile in Sierra Leone, Gold Coast, inner Nigeria, Nyasaland and the Rand goldfields area.

Thirdly, the Barbary States, many parts of West Africa, southern Uganda, Ethiopia, the middle Nile, the lower Zambesi and Shari rivers, eastern Madagascar, and the Natal coastlands have population densities about equal to the world average.

These areas and those noted in the previous paragraph are essentially ones of high level native agricultural production (except the Rand, where mining and industry are the factors causing the high population density). In many cases irrigation of rich river soils aids in building up population figures. In others, a more skilful native farming technique than is evident

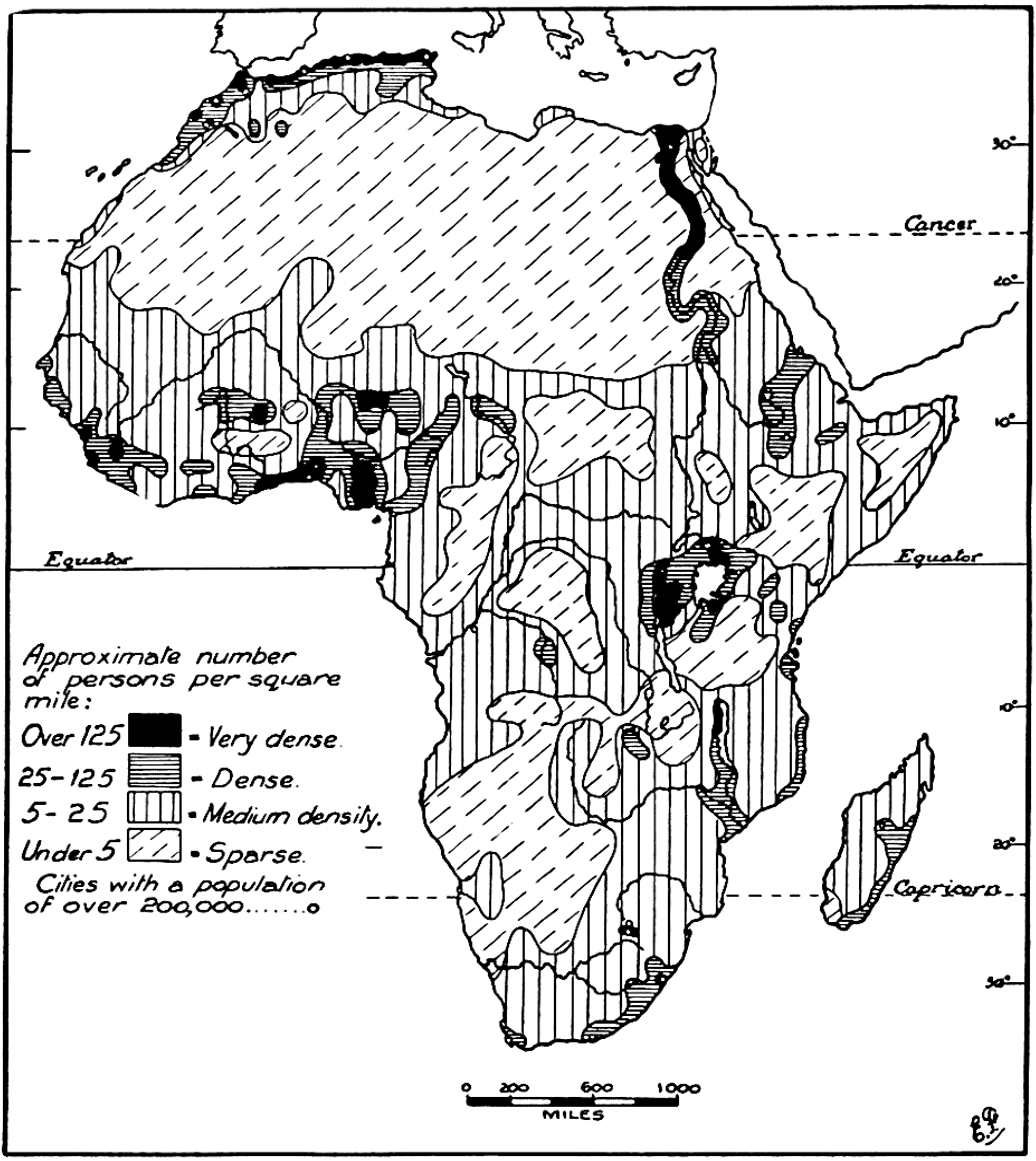


FIG. 26. *Pattern of population distribution in Africa.*

over most of the continent has resulted in small areas of high density. This is especially the case round Victoria Nyanza and in West Africa and Nyasaland.

Outside the areas of high development and high densities most of Negro Africa and white South Africa is moderately populated. The Negro areas are inhabited largely by rather primitive farmers and South Africa by white farmers who mostly practise a large-scale commercial form of agriculture. Both of these forms of land occupancy tend to give low average population densities. This will be discussed more fully in the section on Land Use (Chapter VI).

**2. Development of cities in Africa.** Desert Africa and rain forest Africa are both thinly populated as the peoples there spend too much of their lives in a constant struggle against extreme aridity or overwhelming vegetation growth to be anything but sparsely scattered throughout either regional type. City (or urban) population is not a marked feature of the African scene as native life tends to revolve round the village or kraal (meaning a village or enclosed park and equivalent to the Spanish word "corral"). Only where European influence (with its mining, industry and commerce) has operated strongly are cities of any size to be found. In all Africa there is only one city with over a million people: (Cairo 2,200,000); only five with populations between 500,000 and 1,000,000: (Alexandria 925,000, Johannesburg 900,000, Cape Town 650,000, Casablanca, 600,000, Durban 500,000); and eleven with a population between 200,000 and 500,000: (Tunis 380,000, Ibadan 350,000, Algiers 320,000, Pretoria 300,000, Addis Ababa 300,000, Oran 260,000, Marakesh 250,000, Lagos 250,000, Port Elizabeth 220,000, Tananarive 200,000 and Nairobi 200,000).

## The Peoples of Africa

**1. General Features.** As Figure 27(a) shows, there are three major groups of peoples in Africa:

(*a*) The Hamitic–Arab races of North Africa;

(*b*) Negro Africa, which occupies all of the continent south of the Sahara;

(*c*) South Africa, where peoples of European stock form an important minority.

Figure 27(b) shows that the distribution was not always what it is now. Much movement and mixing of peoples in Africa has taken place as the result of invasion by outsiders, particularly the Arabs and Hamitic peoples. This movement and mixing has occurred principally along the more open savanna grasslands and woodlands (check with the vegetation map, Figure 18). Usually the native peoples stayed under the rule of the invader and gradually intermarried with them to give mixed Hamitic-Negro or Semitic-Negro types. Occasionally groups of natives fled into the fastnesses of the jungle or out into the desert, which sheltered them from further conflict or into rugged mountain areas like Abyssinia. Thus, each of the barriers to movement also became a refuge for those native peoples who were prepared to use them and live under the harsher conditions imposed by them.

**2. North Africa.** The basic and apparently original stock here is the Hamites, whose physical features may be summarised as: fairly tall ( 5 ft 6 in. to 5 ft 8 in.), with light-brown skin colour and dark frizzy or wavy hair. Their faces are straight (as opposed to the prognathic features of the average Negro) and they have straight thin noses and rather thin lips. Members of this stock formed the basic population of the Egyptian

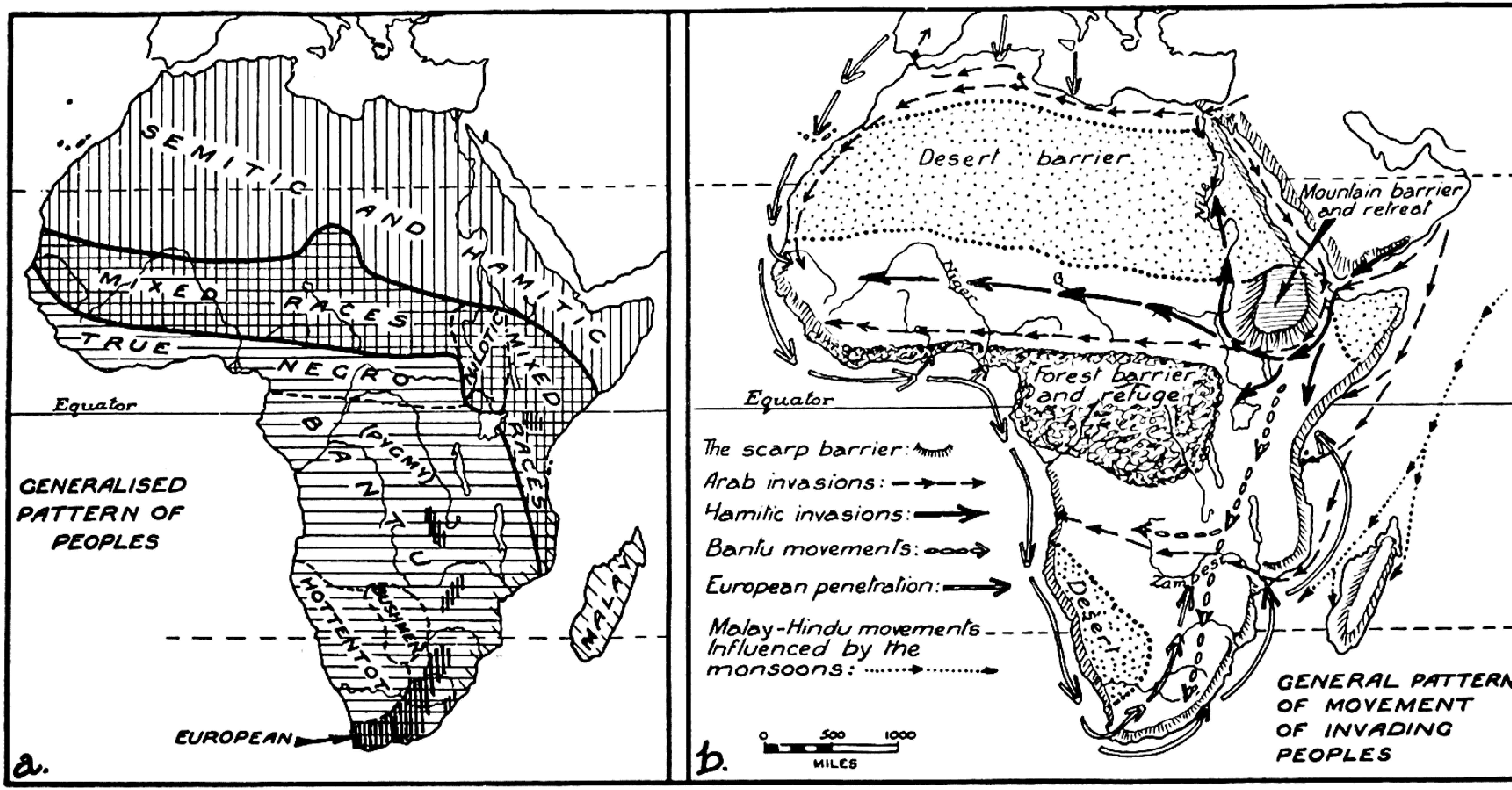


FIG. 27. (*a*) *Simplified distribution map of the peoples of Africa.* (*b*) *General pattern of movement of peoples into Africa.*

peoples, and from there are found southwards through Abyssinia and Somaliland to Kenya. They also occur westwards throughout the Sahara and, as the Berbers, are the major ethnic stock in the Barbary States.

The Hamites are essentially sedentary and agricultural peoples whose society is organised into a large number of small and democratic village communities, where general affairs of government, religion and law are in the hands of a small elected group of adult male citizens. Only on the arid desert margins do the Berbers and other Hamites abandon agriculture for pastoral nomadism. Their agricultural way of life has also fostered the development of a considerable degree of communal life and community work, e.g., harvesting of crops.

During the eighth and ninth centuries the whole of this region and much of the northern part of Negro Africa was invaded and conquered by Semitic Arab peoples who implanted the Mohammedan religion on all peoples of north Africa. These Semites are of medium stature (5 ft 2 in. to 5 ft 6 in.) with jet-black wavy hair and a narrow, usually convex, nose (the so-called Jewish nose). Their skin colour varies but is usually a golden brown. Although the Arabs are basically nomad pastoralists, they may be classified into three groups:

(*a*) True nomads or "camel men", who roam far and wide over the desert lands of south-west Asia and the Sahara. They live in small tribal groups under the absolute control of a sheikh and are great traders as well as nomad herders.

(*b*) The "cattle men", who are nomadic herders found mainly in the eastern Sudan and southwards towards Kenya.

(*c*) The settled agriculturalists of the oases and of the Nile Valley. Here the Arab invader has intermarried with and largely been absorbed by the older Hamitic peoples. Only the Mohammedan religion which they brought remains as evidence of their coming.

Both Hamitic and Semitic peoples have moved at various times through the broad belt of savanna grasslands south of the Sahara. Figure 27(b) suggests something of this movement and Figure 27(a) indicates that they have freely intermarried with the original Negro peoples of these lands to give a broad band of very mixed races, stretching from the Atlantic seaboard east to Kenya and coastal Tanganyika. Figure 27(b) also indicates much Arab penetration of east Africa and central southern Africa. These routes were freely used by Arab slave gatherers from the sixteenth century to the late nineteenth century. Once again considerable admixture of Arab and Negro peoples has occurred, though here the Negro is still the dominant race.

The sweep of Arab and Hamitic invaders through the Sudan was followed by a wholesale conversion of the native races there to the Mohammedan religion. All peoples of the mixed race belt (Figure 27(a)) profess Mohammedanism, though many of the older and more deeply implanted savage beliefs and rites are still to be found among them.

**3. Negro Africa.** Four main types may be distinguished among the many tribes, clans and groups of Negro peoples who inhabit Negro Africa (Afrique Noire):

(*i*) Primitive peoples who now live in scattered tribes in the security of the forest refuge or the repellent landscape of the Kalahari;

(*ii*) the true Negroes of the Guinea and Sudan areas;

(*iii*) the Bantu, who occupy most of the continent south of the Equator;

(*iv*) mixed Hamitic-Negro peoples of the Sudan and Kenya.

(*a*) *Primitive peoples*, often called negrillo peoples, are short in stature, ranging from 4 feet 6 inches with the pygmies to about 5 feet 3 inches with the Hottentots.

(*i*) *The Pygmies* of the Congo Basin live in small communities and depend on hunting and the gathering of nuts, fruits and roots for their food supplies. They have pronounced negroid features with very broad noses and marked prognathic jaws.

(*ii*) *The Bushmen* are a hunting people who were driven from their original homeland in the Upper Zambesi and Lake Nyasa region by southward moving Bantu peoples (see Figure 27(b)). This expulsion probably took place during the seventeenth century and was hastened and aided by Dutch colonists during the eighteenth and nineteenth centuries. They now wander over the Kalahari fringe in search of the game which is their only food.

(*iii*) *The Hottentots* were also driven from their old homeland in South Africa and Transvaal by Bantu and European peoples. The few remaining tribes now practise their nomadism in the harsh environment of the Kalahari Desert and the Bechuanaland protectorate. Elsewhere the tribal organisation has been destroyed by contact with the whites, and the Hottentot now remains as a half- or quarter-caste type among the Cape coloured people.

(*b*) *The true Negroes* of the western Sudan represent a few remaining groups of the original Negro stock. They are tall (5 ft 8 in. to 6 ft), with black or very dark-brown skin with tightly curled woolly hair. They have broad noses, long heads with prognathic jaws and everted lips. Where unaffected by foreign culture they are cultivators, using the hoe as their basic implement, and depending on millet, yams, beans and bananas. For a thousand years from A.D. 900 to the twentieth century they were grouped into various kingdoms such as the Wolof Kingdom of Senegal, the Mandenga Kingdom of most of inland West Africa, the Ashanti Kingdom of the present Gold Coast and the Yoruba Kingdom of southern Nigeria. In many instances these older kingdoms were reorganised by Mohammedan invaders into emirates and caliphates under Hamitic-Negro and Semitic-Negro ruling classes.

As mentioned above, all parts of the Sudan show the effects of the infiltration of Hamitic and Semitic peoples in the great variety of mixed racial types now present there. Many of the nomadic peoples of the Upper Nile (Nilotic Negroes), Abyssinia, Kenya, Uganda, Tanganyika and Somaliland are Hamitic-Negroid mixtures. The Dinka, Shilluk, Masai and Nandi are among the better known of these mixed types. All are basically warlike nomads, though the Nandi have lately adopted agriculture while still remaining cattle owners.

(*c*) *The Bantu.* This great mass of Negro peoples, numbering over 50 million, all belong to one general linguistic group known as the Aba-ntu (or Bantu). Racially it includes many shades from pure Negro to marked Hamitic-Negro mixtures on the northern and eastern borders of the area occupied (see Figure 27(a)). Two main culture groups are recognisable among them.

(*i*) A military and pastoral type who live in a strongly built kraal surrounded by defence works for protection of both the people and their all-important cattle. Each tribe is ruled by a chief whose power is absolute and the whole organisation is along military lines. The Zulu and Matabele are good examples of this type of organisation. Though the military organisation still remains, much of its original power has been broken by the European invaders.

(*ii*) The agricultural and industrial tribes, being less warlike, have been mostly forced into the poorer country, where they cultivate the lands adjoining their kraals, which are unfenced and unprotected. Tribal organisation differs from the warlike groups in that a council of elders elects the chief and aids him in ruling.

## Contact between Negroes and Europeans

After they had been forced out of their homeland by invading Hamitic peoples (see Figure 27(b)), the southern groups of Bantu moved into the area south of the Zambesi at about the same time as the European settlers. During the nineteenth century there were fierce clashes between the two racial groups contesting for farming and grazing lands. Today, except on special native protectorates such as Swaziland, Basutoland and Bechuanaland, the Bantu tribal organisation has been practically destroyed and the Negro people have become partly assimilated into the European economy as menial workers on the farms, in the mines or in the towns. This destruction of the age-old tribal system and the failure to replace it by a full and equal partnership in European life has been the cause of an ever-growing strife and increasing tension between displaced native peoples and the European overlords.

This tension has mainly resulted from a competition for land between European and Negro inhabitants. In those parts of Africa where the climate is attractive, Europeans move in and wrest farming land from

the native peoples. This has occurred in South Africa and Kenya and to some extent in the Barbary States. The native is at a disadvantage here in being unable to organise concerted resistance to the better equipped immigrants. He loses his rights to his land and is either forced to remain as a low menial worker for the white settler or to move into less hospitable areas set aside as native reserves—mainly because the European settler does not want them. Either course breeds resentment in the minds of the Negroes, and on occasions this flares into open rebellion, as with the Mau Mau in Kenya.

In the more unfavourable climatic regions of Africa such as West Africa, the Sudan and Uganda, the European came in the first place to exploit the resources of the country. He was able to do this best by organising the native farmers to produce (or collect) the particular crop he was interested in. In time the native was able to take over more and more of the control until finally it all passed into his hands. This has occurred with the cocoa production of West Africa. In the governmental field also, the European has been content to allow the general development of democratic self-government, and in the Gold Coast and Nigeria there is now an almost complete form of self-government, with an English Governor and a few English advisers to the natives in the Government departments. Here there is harmony between white and black mainly because there is no basic competition for the farmland.

## EXERCISES

1. **Vocabulary words and phrases:** commercial agriculture, kraal, prognathic features, negrillo, everted lips.

2. (a) What is meant by the term "population density"? Using a population map of the world (such as in Ford and Rowe: *People and Place*; or Finch and Trewartha: *Elements of Geography*; or Davis: *Earth and Man*; etc.) try to establish some general relationships between population density and human occupations.

(b) A further exercise could examine the relation between population density and the natural factors of landforms, climate and soils.

3. Describe the movement of peoples into Africa in relation to the physical geography of the continent and the present pattern of racial distribution.

4. Discuss the general relationship between population distribution and geographical features (landforms, climate, soils, vegetation and minerals) in *one* of the following areas:—

(a) Africa north of the Tropic of Cancer;
(b) West Africa;
(c) Equatorial Africa;
(d) Africa between 10° S. and 20° S. latitudes;
(e) Africa south of 15° S. latitude.

5. Compare and contrast the distribution of population in Nigeria and Tanganyika giving reasons for any differences you may notice.

(Note: Similar comparison questions could be worked out for any other pair of regions in different parts of Africa.)

# CHAPTER VI

# LAND USE IN AFRICA

Study Figure 28 to notice the following general points about African land use:

(*a*) Approximately 20 per cent of the continent is desert, wherein the only land use consists of widely scattered small agricultural groups round oases, or occasional mining settlements as in the Tsumeb district of the Kalahari.

(*b*) Practically all of the remainder of Africa is inhabited by subsistence farming peoples in varying stages of advancement.

(*c*) Only in South Africa, Southern Rhodesia, the Barbary States and a few scattered districts in east and west Africa is commercial farming developed. This economic development and exploitation is therefore largely of a peripheral nature, except where it has penetrated to the heart of southern Africa.

As noted in the previous section, manufacturing and its accompanying city development is not a prominent feature of the African way of life. This, at the moment, is centred on animals and crops, with mining important in a few localised areas.

## Subsistence Farming

This is governed broadly by environmental factors. The forest areas correspond with the distribution of the more primitive peoples (and with the development of plantation farming); the savannas are peopled mainly by settled agriculturalists; and the poorer grasslands are occupied by pastoral peoples, with occasional groups of warlike hunters.

**1. Shifting Cultivators.** The most primitive form of farming is the shifting cultivation found in the rain forests of tropical Africa. Here the members of any of the small village units, working as a community group, clear and burn a few acres of the surrounding forest. Crops appropriate to the climate are then planted in the ash-enriched red and yellow soils. The crops include manioc, sweet potatoes, yams, maize, bananas and possibly rice or ground nuts. In due course these are harvested and stored in a special hut in the village for equal sharing among the tribal members. In the following year the ground is chipped over with the hoe and fresh crops are planted. After the third year the soil has lost its temporary enrichment from the ashes and a fresh plot has to be cleared in another part of the forest. The first plot is quickly covered by secondary-growth

woodland and scrub. This process is repeated until all suitable land near the village has been farmed and it becomes necessary to re-clear the first plot. If each plot has been allowed to rest for at least fifteen years it may be assumed to be suitable for the second clearing and cultivation.

Though this system has been condemned as wasteful of the natural forest it has some good points. The land cleared, being in small patches surrounded by dense vegetative growth, rarely suffers soil erosion. The cultivation by the hoe (the universal African farming implement) is the only type possible among the massive stumps which litter the fields. The quick return to natural vegetation cover prevents any serious oxidation of the soil.

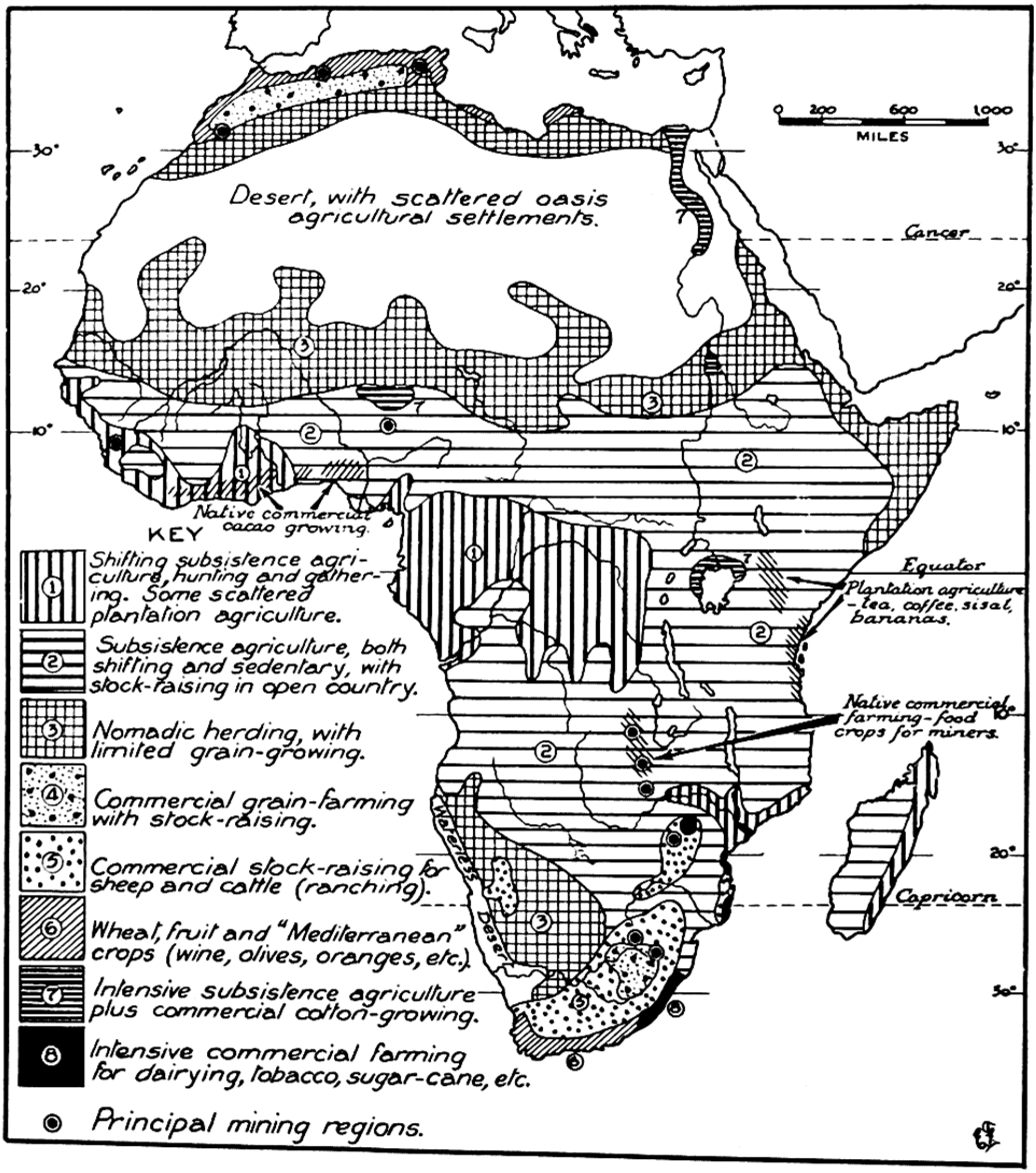


FIG. 28. *Generalised pattern of land use in Africa.*

Where the tribes are small and scattered so that the population density does not exceed 100 per square mile this form of land use would appear to be the best form of adaptation by a primitive people to a soil which needs long periods for recovery and regeneration after being cultivated. The alternative of constant cultivation with heavy annual fertilising is outside the province of native farmers.

**2. Sedentary Subsistence Farming.** Surrounding the core of shifting cultivation (see Figure 28) is a broad zone of savanna woodlands and grasslands inhabited by sedentary cultivators and animal breeders. The major crops of this area are millets (mealies), maize, ground nuts and rice along some of the rivers. Cattle, with smaller numbers of sheep and horses, are bred and some tribes in this area are exclusively pastoral. In the wetter areas (nearer to the core) the tsetse fly prevents the raising of animals, and the farming is purely agricultural with yams, manioc, maize, sweet potatoes, bananas and ground nuts as the main food crops. In West Africa cocoa has become the main cash crop for the native peoples, though gathering palm oil and kola nut and growing ground nuts for sale are also of great commercial importance to these advanced native cultivators.

In East Africa this form of cultivation still occurs; but on areas free from the tsetse fly the settled cultivators tend to be ousted by warlike pastoral tribes, such as the Masai.

Beyond the savanna lands lie the semi-arid pastures (Number 3 on Figure 28) inhabited by nomad pastoralists who roam over huge tracts of land in search of water and grass brought by the small seasonal rainfall. Irrigation settlements, such as those established in the Gezira by the British and on the Upper Niger Delta by the French, have resulted in a much more intensive use of the land, with an intensive farming of cash crops. This is discussed more fully under the various regional studies.

The Mediterranean lands have an agriculture dating from Roman times based on the growing of cereals (wheat, barley, oats), olives, figs and above all, the grape. This land use is both subsistence and commercial in its outlook.

## Commercial Farming

Apart from the Mediterranean coastlands this may be examined under four headings:

1. Irrigation crops of the Nile, Gezira and Upper Niger;
2. Native commercial crops such as cocoa;
3. Plantation agriculture;
4. Individualistic farming by Europeans in South Africa.

Each of these will be examined more fully in the later regional studies. Here it is sufficient to note something of the patterns of settlement developed by them.

**1. In the irrigation farming**, the river flood-plain is a checkerboard of plots with various crops. The villages are mostly along the higher, and non-irrigable, marginal land. The crops are principally cotton, sugar, rice, maize, onions and fruits from the lower Nile; cotton from the Gezira; and cotton, ground nuts and rice from the Upper Niger Delta.

**2. Native commercial agriculture** is a development from the older subsistence farming. The latter is still practised; but there are now the additional cash crops, which are sold through co-operatives and agencies for overseas export or for use in nearby towns. The major crops are cotton, ground nuts and cocoa (cacao plant) from West Africa (together with the gathering of palm oil and kola nuts); cotton from the Victoria Nyanza region, food crops for the Katanga mining centres, and cloves on Zanzibar and Pemba islands.

**3. Plantation agriculture** has not been developed as much in Africa as in the south-east Asian or Caribbean regions. It is confined mainly to bananas, oil-palms and some rubber from West Africa; sisal hemp, bananas, tea and coffee from East Africa; and sugar from Natal.

**4. Individualistic European farming** is found mainly in South Africa and Southern Rhodesia. Sheep and cattle, with maize, wheat, fruits, and the vine are important in South Africa, while Southern Rhodesia has livestock and tobacco, oranges and sunflower seed crops. There is also a small development of European individualistic farming for tea, coffee and sisal in the Nairobi area of Kenya.

## Trade

The major farming export commodities are wool and meat from South Africa, the crops of the plantations (sisal, coconuts, palm oil, bananas, coffee and rubber) and the main native crops of cotton, cocoa and ground nuts.

There will always be plant exports from Africa, as many of the crops are essential to the continued welfare of temperate lands, especially where settled by Europeans. Whether this export will be supplied by plantations or by increasing native farming production is discussed more fully under the chapter on Tropical Lands in Chapter XII.

## EXERCISES

1. **Vocabulary words and phrases:** shifting agriculture, subsistence farming, manioc, yams, sedentary subsistence farming, tsetse fly, kola nut, individualistic farming, sisal hemp.

2. Compare and explain the differences in land use in the High Veld of South Africa and the Abyssinian Plateau.

3. Describe the general activities of each of the following groups of people:
   (a) nomad herders in the Sudan;
   (b) shifting cultivators in the forest lands;
   (c) sedentary cultivators of the savanna woodlands.

4. Draw a map of Africa to show the distribution of the various commercial farm products throughout the continent. Comment on the pattern shown on your map.

# CHAPTER VII

# REGIONAL STUDIES

## South Africa

**1. Area and Population.** The South African region is occupied by (*a*) British South Africa, which includes the Union of South Africa (Cape of Good Hope, Natal, Transvaal and Orange Free State) and its dependent protectorates; and (*b*) the newly formed Federation of British South Central Africa, which embraces Northern Rhodesia, Southern Rhodesia and Nyasaland. Basic statistical information regarding these is:

| *Name* | *Area (square miles)* | *Population (1954)* |
|---|---|---|
| Union of South Africa | 473,000 | 13,300,000 |
| South West Africa | 318,000 | 410,000 |
| Basutoland (Prot.) | 12,000 | 570,000 |
| Bechuanaland (Prot.) | 275,000 | 300,000 |
| Swaziland (Prot.) | 7,000 | 200,000 |
| British South Africa | 1,085,000 | 14,780,000 |
| Southern Rhodesia | 150,000 | 2,200,000 |
| Northern Rhodesia (Prot.) | 288,000 | 2,000,000 |
| Nyasaland (Prot.) | 37,000 | 2,400,000 |
| British South Central Africa | 475,000 | 6,600,000 |

The maps in the map-summary of South Africa in Figure 29 do not show all of Northern Rhodesia or Nyasaland, but they include portion of the Portuguese colonies of Angola and Mozambique in addition to the British territories.

**2. Landforms.** South Africa consists of two main physical regions; the High Plateau and the plateau scarps and coastal lowlands. Both of these may be subdivided because of differences of landforms occurring within them.

Figure 29(a) shows the plateau as being composed of the High Veld, which is mostly above 4000 feet in elevation and is above 5000 feet in parts of Transvaal. The High Veld passes northwards into the High Plateau and hilly uplands of Southern Rhodesia, where much of the country is between 4000 feet and 5000 feet. Westwards it falls away to the great Bechuanaland hollow, with an average elevation of about 2000 feet, and westward again it rises to the 3000-foot plateau of South-west Africa.

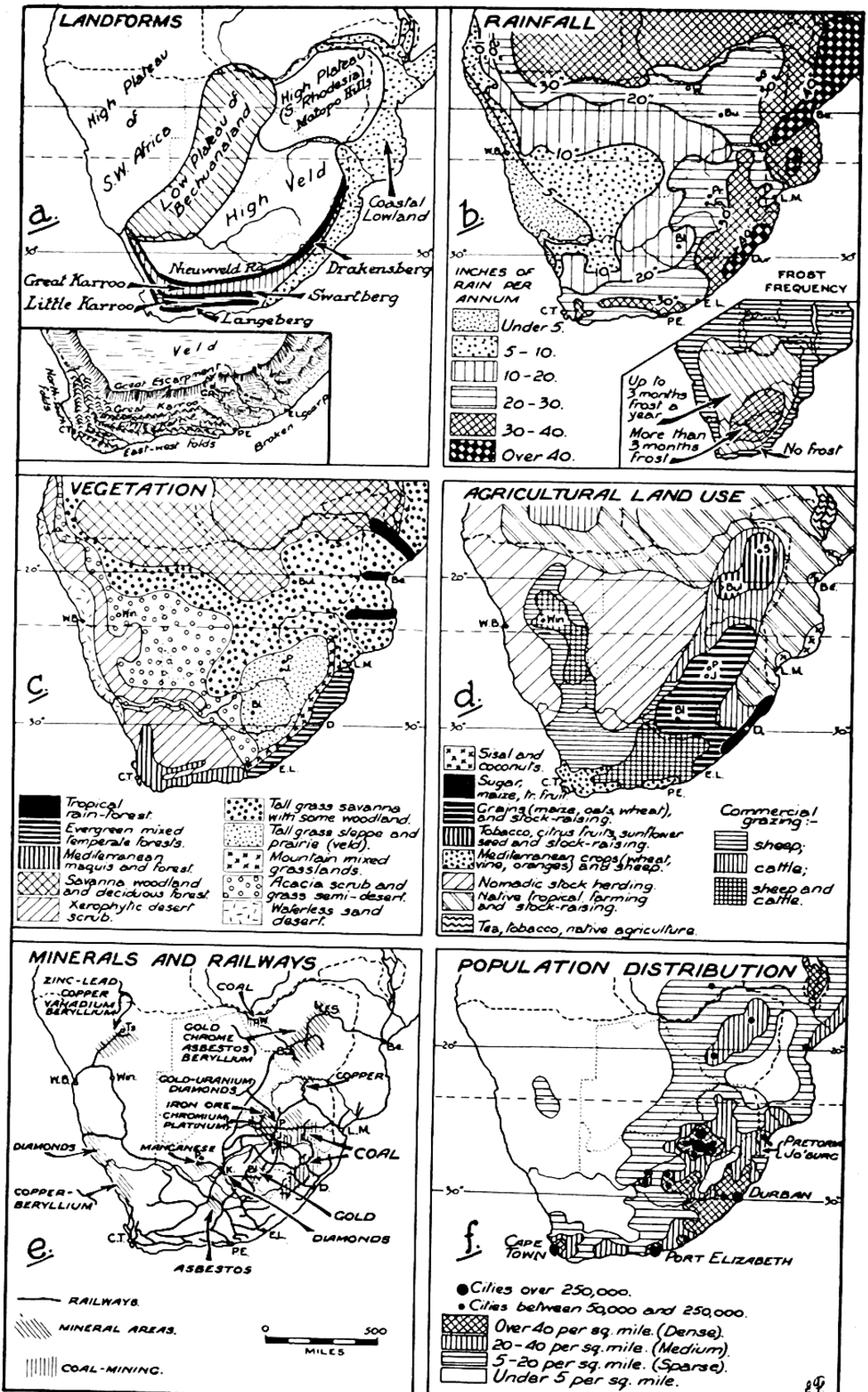


FIG. 29. *Map-summaries to illustrate the main features of South African geography.*

The plateau scarps and coastal lowlands flank the plateau on the east and south. On the west it drops into the sea by great cliffs. Again, as the inset to Figure 29(a) shows, much variety of landform occurs throughout this major zone.

First, there are the step-fault plateaux of the Great and Little Karroos on the south. These are flanked by the fold ridges of the Langeberg, Swarteberg and Nieuwveld Ranges, which pass westward into the Cape Ranges and eastwards into the mighty Drakensberg scarp-edge of the High Plateau.

Secondly, the east coastal lowlands resemble the east coast lowlands of Australia in that they consist of broken foothill country with spaced river alluvial plains on which most of the settlement has developed. Northwards, in Mozambique, the highlands retreat inland and the coastal lowlands become a wide and continuous coastal plain.

3. **Climate.** First revise the general climatic maps and notes on Africa in Chapter II. These will show that temperatures are warm or hot on the coastal lowlands but are greatly modified by the elevation of the inland plateau. The frost frequency map inset of Figure 29(b) emphasises this point.

The rainfall map (Figure 29(b)) shows that South Africa is mostly a dry land with a steady decrease in rainfall from the east to the west. Only the eastern coastal lowlands and adjoining scarplands have a good rainfall, mostly from the orographical effect of the Drakensberg and Motopo mountains. Elsewhere, and particularly on the inland areas of the High Veld and Bechuanaland, the moderate 15- 30-inch rainfall is less valuable because of its capricious nature in Transvaal and Orange Free State and its marked summer incidence in the Rhodesias. Cape Colony has a moderate to poor winter rainfall while South-west Africa is desert or semi-desert.

4. **Vegetation** is a reflection of the rainfall, both in amount and in seasonal distribution. The dominant vegetation types are grassland, scrubland and xerophytic desert shrubs (shown by dots, strokes or crosses on Figure 29(c)). This is a direct response to the low, erratic or seasonal rainfall of most of the inland and helps to explain the dominant part played by animals and grazing in the South African economy.

In the north, where the rainfall is greater, are savanna woodlands and tropical deciduous forests which pass ultimately into true forests nearer the Equator. Cape Colony is covered with scrublands of the maquis type, which change gradually to evergreen mixed forests on the wetter Natal coastlands. The only rain forests are found as gallery forests along the lower courses of the Zambesi and other Mozambique rivers.

5. **Agricultural land use.** Figure 29(d) broadly summarises the farming activities of South Africa, and, as noted above, these are dominantly concerned with the grazing of animals both commercially and by the native subsistence farmers. The core of this form of agricultural land

use is the mixed grain growing (maize, oats and wheat) and stock raising (cattle and sheep) of the "maize triangle" of Transvaal and the Orange Free State and the nearby coastal lowlands. This is surrounded by and extends into the widespread commercial grazing areas for merino sheep and beef cattle which extend from Southern Rhodesia round Bechuanaland to South-west Africa.

Southern Rhodesia, because of mild temperatures and a fairly high rainfall, is showing an agricultural development based on orange orchards, tobacco growing and growing sunflower seed as well as the ever-present cattle raising (see Figure 29(d)).

Cape Colony has a considerable growth of the vine (mainly for wine), oranges and wheat as a commercial crop. The hotter and wetter Natal has sugar plantations and grows bananas, pineapples and maize.

Elsewhere, as Figure 29(d) shows, the land is devoted to nomadic herding or native crop growing and stock raising as described in a previous section (Chapter VI).

**6. Minerals and Railways.** South Africa and South Central Africa are exceptionally well endowed with a great variety of metallic minerals as well as having the only significant coalfields in the African continent. Figure 29(e) shows that the mineral areas are grouped mainly in central Southern Rhodesia, central Transvaal and central Orange Free State, with scattered areas in South-west Africa and Cape Colony. The coalfields are in eastern Transvaal and north-western Natal with a smaller, but significant, field at Wankie. Though gold and diamonds are traditionally associated with the South African mineral development, Figure 29(e) shows that there is a great variety of other significant minerals produced.

The railway pattern closely follows the denser settled areas, with occasional lines extending to outlying mineral areas as in South-west Africa, or to ports as at Beira. It is therefore best developed in southern Transvaal, Orange Free State, Natal and south-eastern Cape Colony, where climatic conditions have resulted in the most intensive development of agriculture and grazing.

**7. Population distribution.** Two facts are noticeable about the distribution of population as shown in Figure 29(f): (*i*) the dense grouping of peoples on the better lands; and (*ii*) the comparatively large number of cities for an African region. As the table at the head of this chapter shows, the total population of all South and South Central Africa is approximately 21½ million, of whom a mere three million are Europeans. Of the remainder, some 17 million are Bantus, about one million are coloured (half-caste and Hottentot) and nearly 400,000 are Asiatics (mainly Hindu peoples in Natal).

About three-quarters of the European peoples live in towns and cities, and each of the large cities has a considerable population of native workers, who often, as in Johannesburg, Cape Town, Durban or Port Elizabeth, outnumber the whites. The clash between black and white

peoples for the farming land, followed by an ever-increasing number of restrictive Acts passed by the white parliaments against the blacks, has resulted in a very strong feeling of ill-will on the part of the native peoples. Just what will be the eventual outcome of the tension throughout this area is difficult to foresee; but it could have a profound effect on the general relationships between European and coloured peoples throughout the African continent.

## East Africa

**1. Area and Population.** The East African region comprises the following countries:

| *Country* | *Area (square miles)* | *Population (1954)* |
|---|---|---|
| Ethiopia | 395,000 | 16,000,000 (?) |
| Uganda | 80,000 | 5,500,000 |
| Kenya | 220,000 | 6,000,000 |
| Tanganyika | 342,000 | 8,000,000 |
| Zanzibar and Pemba | 1,000 | 300,000 |
| Mozambique | 200,000 | 6,000,000 |
| Nyasaland | 37,000 | 2,500,000 |
| British and Italian Somaliland | 205,000 | 2,000,000 |
| Southern Sudan | 400,000 | 7,500,000 |
| Approximate Totals | 1,880,000 | 53,800,000 |

It is a vast land over which there will be considerable variations in landforms, climate and human occupations.

**2. Physical features.** Most of this region is portion of the High Plateau and its northern extension (see Figures 2 and 3), crossed by the Great Rift Valley (see Figure 5) and flanked by a coastal lowland of varying width.

The high elevation is an important agent in modifying the temperatures throughout much of the region.

**3. Climate and vegetation.** (Refer to Figures 17 and 18). All the area is between 15° N. and 15° S. and experiences an altitude-modified form of the equatorial hot-wet climate in a belt through the centre flanked to the north and south by savanna summer-rain climates with varying amounts of rainfall (see Figures 14, 15 and 20).

The vegetation never reaches the density of rain forests except in small patches along some coastal rivers and round the lower slopes of Kilimanjaro and other volcanic peaks. Many of the wetter portions of the Tanganyika interior and Ethiopian uplands are clothed with tsetse-infested deciduous tropical forest, with patches of mountain forest and moss forest on the wetter upper slopes of Kenya mountain lands (the "Highlands" area). Elsewhere the interior is covered with tall-grass and

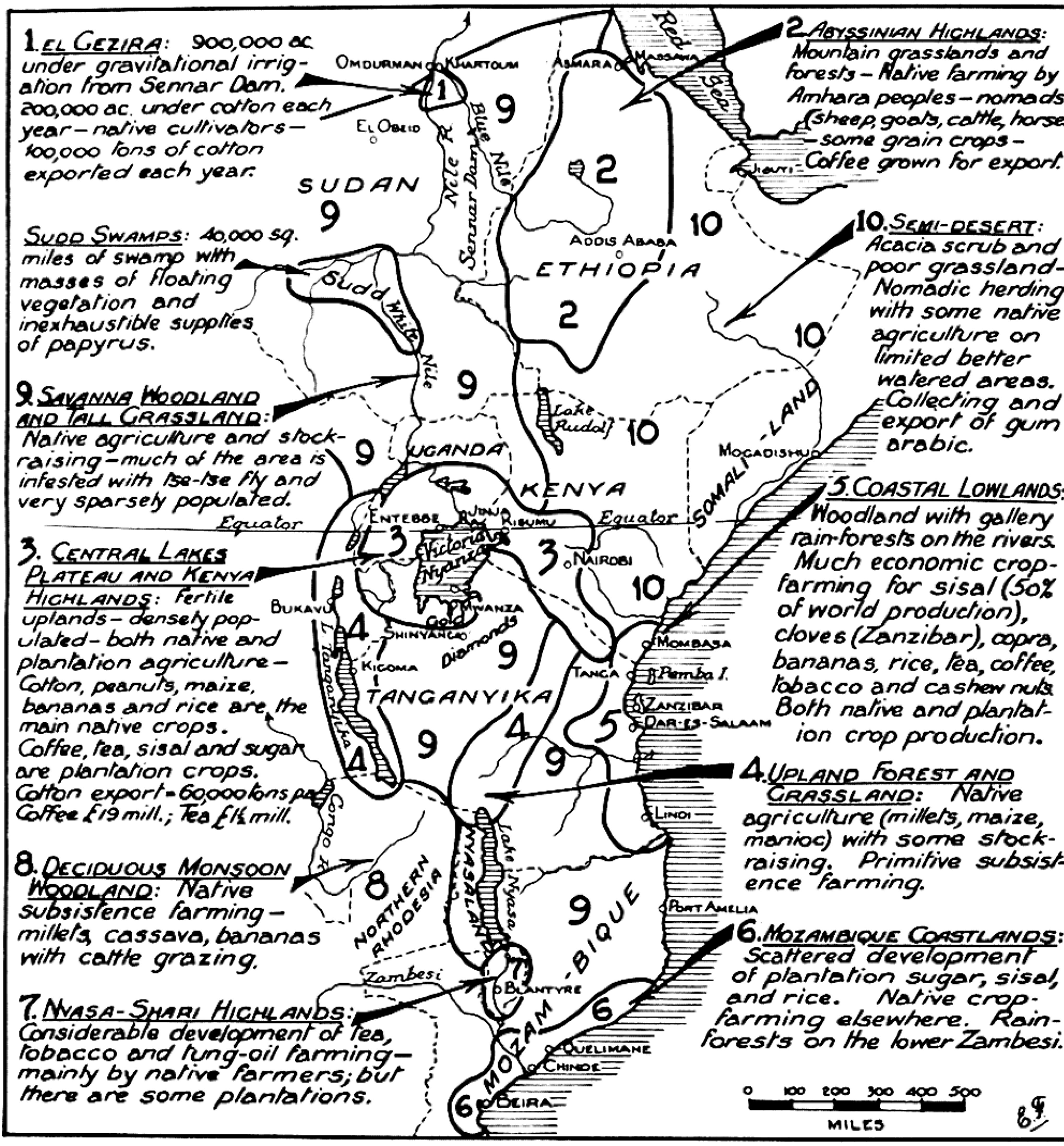


Fig. 30. *Sub-regions of East Africa and a map-summary of their main geographical features.*

high-grass savanna, with mountain grasslands on the highlands to the west of Victoria Nyanza and in central Ethiopia. The Somaliland landscape is one of desert shrub and desert grass savanna, where nomad herders have their homes.

**4. Regional study.** (Refer to Figure 30.) Economically, most of this area is developed by native subsistence cultivators and herders. Practically all of the sub-regions 2, 4, 8, 9 and 10 are so developed and, as Figure 30 shows, the differences among them are only in the form of subsistence utilisation or in landform type.

The native agriculturalists here (sub-regions 2, 4, 8, 9) use the hoe as their essential farm implement and practise widely varying farming

techniques to grow crops of millets, maize, manioc, bananas and occasional commercial crops of coffee, ground nuts, cotton and tobacco. Where the areas are free from the tsetse fly considerable numbers of cattle are kept, more as a sign of wealth than as providers of meat and milk.

On the northern edge of this area in the triangle formed by the Blue Nile and White Nile is the Gezira. By building a huge dam at Sennar on the Blue Nile the British were able to irrigate over 900,000 acres in this Gezira triangle by canal irrigation. What was once a barren waste is now a checkerboard of fields under a variety of crops or lying fallow between cultivation. The whole scheme is to enable the development of native crops, both commercial and subsistence. Each year over 200,000 acres are planted with cotton, and this is rotated with legumes, vegetables and subsistence grain crops. About 100,000 tons of long-stapled sakellerides cotton is exported yearly, mainly through Port Sudan.

In the drier Number 10 area and in parts of Number 9 area (especially in Kenya and Tanganyika) native nomad herders roam over the grass-lands with herds of cattle and flocks of sheep or goats.

Commercial crop production is principally the result of European development of plantations of tropical crops required by the inhabitants (and factories) of cooler temperate lands. In addition there has been considerable development of native commercial agriculture (plus some gathering of products) for cotton in the Gezira and south-west Uganda; ground nuts in Uganda; cloves on Zanzibar and Pemba islands; sesame seed round Lake Victoria; and tea, tung oil and tobacco from Nyasaland.

The major plantation crops are sisal and bananas from the Tanganyika coastlands and the Nairobi area of Kenya; coffee and tea from Kilimanjaro and the Highlands of Kenya; sugar-cane and coffee from Lake Victoria; copra from Tanganyika and Mozambique coastlands and tobacco, tea and tung oil from southern Nyasaland. There is also some development of individualistic farming by European peoples for coffee, tea, and tobacco in the Kenya Highlands district and Nyasaland.

Apart from diamonds near Shinyanga and gold mining south of Lake Victoria, there has been little development of minerals throughout this area, though considerable deposits of many useful metallic ores are believed to exist.

There has been some clash of interest between native farmers and invading European settlers as in South Africa, and relationships between the two races are far from perfect.

## Nile Valley

**1. Physical.** Figure 31 is a map-summary of the general geography of the Middle and Lower Nile and the adjoining desert lands. The area above Khartoum was treated broadly in Figure 30 and the whole valley is dealt with in *People and Place* (Vol. I of this series, page 97).

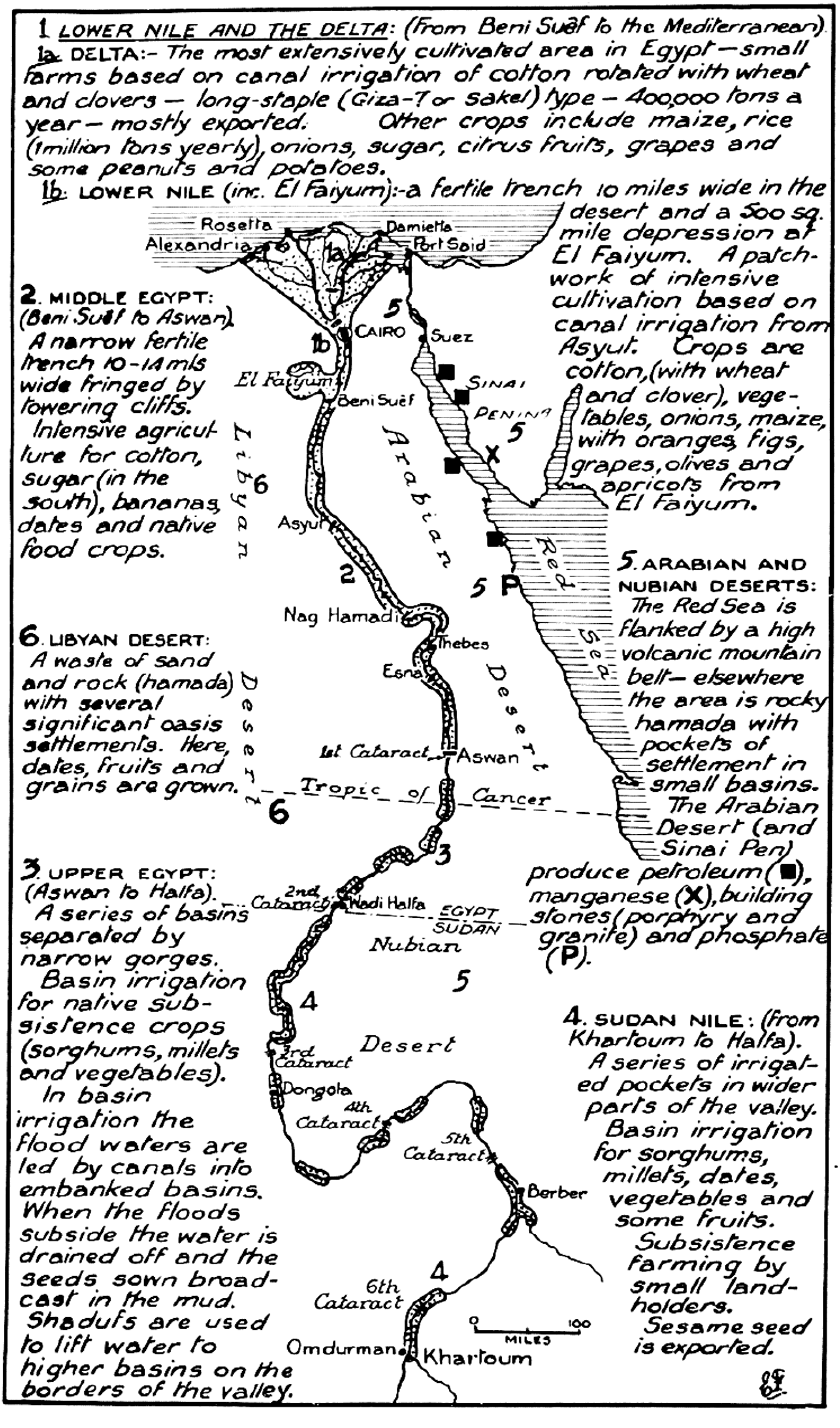


FIG. 31. *Map-summary of the geography of the Nile Valley from Khartoum to the Mediterranean Sea.*

The great significance of the Nile lies in the fact that it brings both a steady flow of water and regular yearly flooding to the fertile valley floor of the portion of the river shown in Figure 31.

Broadly speaking, the Nile runs in a cliff-flanked trench up to fifteen miles wide cutting across the waterless eastern Sahara and at several hundred feet below the general level of the adjacent desert lands. The floor of the trench is covered with deep deposits of fertile alluvium brought down by thousands of yearly floods from the volcanic Ethiopian (Abyssinian) Highlands.

At its mouth the Nile spreads out to form a delta 120 miles wide and 100 miles across. It is said that the resemblance of this particular area to the Greek letter "delta" originally gave the name to this landform.

The construction of a series of barrages on the lower river between Aswan and the sea has (*a*) tended to regulate the annual floodings; (*b*) stored water for winter irrigation of crops, thereby greatly increasing both the quantity and variety of crops possible; and (*c*) enabled the irrigation of considerable areas of the valley floor out of reach of normal floodings but capable of canal irrigation from stored water in reservoirs; the El Faiyum depression has been developed in this manner.

**2. Economic development.** Figure 31 shows that several subdivisions are possible in the valley area. The two main ones are the Lower Nile below Aswan and the Middle Nile above Aswan and upstream to Khartoum. The basic difference between these two sub-regions lies in the different forms of irrigation used. The Lower Nile is almost entirely canal irrigated, while in the Middle Nile the traditional basin type is used, with limited shaduf irrigation away from the river. The political boundary between Egypt and Sudan happens to correspond closely with this land use difference.

(*a*) *The Lower Nile* may be again subdivided into three main subzones: the Delta; the section from Asyut to Cairo; and the section from Aswan to Asyut.

(*i*) *The Delta* is the most widely cultivated area in Egypt. The irrigated crops include the long-stapled sakellerides (sakel) cotton or the newer Giza-7 type with a longer and finer staple; rice (over a million tons a year); maize, sugar, dates, citrus fruits (over 250,000 tons a year), grapes and peanuts. Despite the great wealth of crops, the high population density is such as to keep the farms very small and the general level of existence very low. Cairo at the head of the Delta is the centre of government and trade and is the largest city in Africa.

(*ii*) *The section between Asyut and Cairo* is a typical portion of the Nile trench, with cotton as the dominant crop, together with dates, bananas and other food crops. The 500-square-mile depression of El Faiyum is now irrigated by canals from Asyut and produces the usual cereal and food crops, plus large amounts of fruit (oranges, figs, grapes, apricots, and olives).

(*iii*) *Above Asyut* the valley trench continues but the crop types change to sugar-cane (the major area of Egypt for this) and bananas in addition to the native food crops. Thebes is the centre of sugar refining.

(*b*) *The Middle Nile.* Above Aswan there are no further barrages for 1000 miles until Jebel Aulia and Sennar are reached. The valley floor here is irrigated by traditional basin methods (see Number 3 on Figure 31) to produce mainly native food crops and some seven per cent of the world's sesame seed crop.

Throughout the whole valley the main native food crops are cereals (wheat, barley, maize, rice), vegetables (beans, peas, lentils, onions) and fruits (grapes, stone fruits, citrus fruits).

Away from the river, settlement is confined mainly to the oases, which grow subsistence food crops and dates for export as well as for use by the nomad traders of the desert.

At the northern end of the Red Sea, round the Gulf of Suez, are important mineral-producing areas. Among these, petroleum in the Sinai Peninsula, phosphates at Safaga, and manganese in southern Sinai are the most important.

Egypt's population of 20 million is greatly overcrowded on the 14,000 square miles of cultivable land, and the average density of nearly 1500 per square mile means a very low standard of living despite the prodigious labour of the fellahin on a very fertile soil with the aid of good water supplies.

## Barbary States

This regional subdivision of Africa includes the Atlas Mountain area and the northern Saharan edge. It comprises the State of Morocco, Spanish Morocco, Tunisia and the northern half of Algeria.

The area shown on Figure 32 is approximately 450,000 square miles (the size of south-east Australia, east of a line from Brisbane to Adelaide); and its population is nearly 21 million, of which about 800,000 are French and Italians.

**1. Build and landforms.** Reference to Figure 4 shows that practically the whole of the Barbary States is occupied by the Atlas fold mountain systems and the included Plateau of Shotts. On the western end, in Morocco, is a dissected plateau of old rocks known as the Moroccan Meseta, which is a continuation of the Spanish Meseta of the Iberian Peninsula.

The coastal ranges (the Tell Atlas of Algeria and Tunisia and the High and Middle Atlas of Morocco) are high, rugged and severely folded, as is shown in the section on Figure 4. The inner ranges (the Anti Atlas in Morocco and the Saharan Atlas in Algeria) are less folded, lower and less rugged.

The High Plateau between the two series of folds is covered with a strung-out series of shallow salt lakes and swamps known as *shotts* (or

*chotts*) (see Figure 4). These also occur in a depression to the south of the mountain systems in Tunisia.

On the coastal side are a number of river valley flood plains, which run back for some distance into the mountains, and a narrow and broken coastal plain. Both of these form the principal foci of settlement in the region and the population density in them is often several hundreds to the square mile.

**2. Climate and vegetation.** The climate of the whole area is essentially dry Mediterranean in character, i.e., it has a moderate winter rainfall, decreasing to a few inches a year on the Saharan edge (see Figures 32 and 15); an abundance of sunny weather with very high summer temperatures; and a long dry period during the summer months. Only on the narrow coastal zone between Algiers and Tunis and in the high mountains of the Rif and north central Morocco does the rainfall exceed 30 inches a year. These restricted areas of medium rainfall are the only ones where forests occur. The trees in these forests consist mainly of cork oak, Aleppo pine, thuya (a type of cypress pine), holm oak, cedar and fir.

Inland, on the Shotts Plateau, scrub and grassy steppes (with esparto grass) predominate, while the inner Atlas has steppes with juniper trees

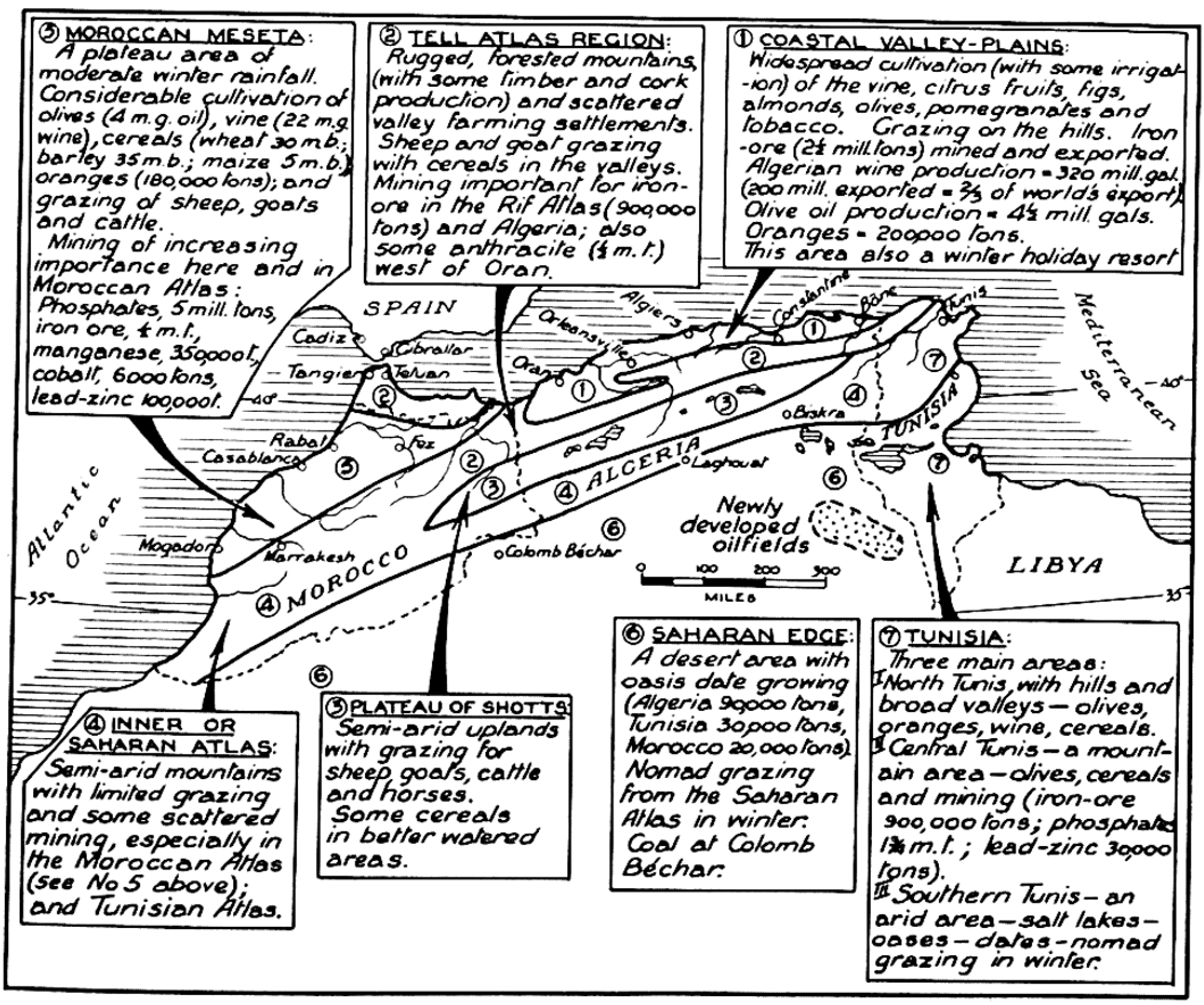


FIG. 32. *Map-summary of the regional geography of the Barbary States of northern Africa.*

and pines on the higher slopes. The desert edge is clothed with typical desert shrubs.

**3. Economic development.** Agriculture is generally important on the wetter coastal and coastal valley areas, while grazing becomes dominant in and south of the Tell and High Atlas. Mining is of great importance in the mountain areas.

The agriculture is partly subsistence and partly commercial in character and, as Figure 32 shows, the crops are typically Mediterranean in character. There is some export of cereals, fruits and wine to France but most of the crops are consumed locally.

The mineral products of the area have long been significant exports, and their number and significance are increasing with the development of cobalt in Morocco. The principal mining products are iron ore, phosphates, lead-zinc ores, and manganese. The iron ore is mined at several coastal centres and is exported to England, Italy, Germany and U.S.A. The phosphates are important in Morocco (at Khouribga) and Tunisia (Gasfa). They are quarried and exported to several western European countries for the manufacture of chemical fertilisers. The other minerals are of less significance. Absence of coal except for a small worked field in north-east Morocco (production about 500,000 tons a year) has so far prevented the development of local smelting or the building up of industrial enterprises other than those concerned with food and clothing. Future industrial development could be based on a fuller use of the potential hydro-electric power of the coastal streams.

## West Africa

**1. Area and population.** This huge area is approximately 2400 miles from east to west and 750 miles from north to south. It includes many political subdivisions; Figure 34 shows these and the following table gives their area and approximate population.

| *Name* | *Area (square miles)* | *Population (1954)* |
|---|---|---|
| French West Africa | | |
| (a) Senegal | 78,000 | 2,200,000 |
| (b) French Guinea | 97,000 | 2,400,000 |
| (c) Ivory Coast | 184,000 | 5,400,000 |
| (d) Dahomey | 43,000 | 1,600,000 |
| (e) French Sudan | 591,000 | 3,500,000 |
| (f) Niger Territory | 500,000 | 2,200,000 |
| Other Territories | | |
| Nigeria | 373,000 | 32,000,000 |
| Gambia | 4,000 | 250,000 |
| Gold Coast | 92,000 | 4,500,000 |
| Sierra Leone | 28,000 | 2,100,000 |
| Portuguese Guinea | 14,000 | 550,000 |
| Liberia | 43,000 | 2,500,000 |
| Total | 2,047,000 | 59,200,000 |

In addition, Figure 34 shows about 400,000 square miles of French Equatorial Africa, with a population of about 2,000,000.

**2. Landforms.** The landforms of such a vast region are naturally very varied, but several major types may be noted.

(*a*) With the exception of the Cameroon Mountains, the Jos Plateau of Nigeria and the Futa Jallon Highlands of French Guinea, the area forms part of the Low Plateau of North Africa (see Figures 2 and 3).

(*b*) The Niger and Volta rivers have carved broad lowland valley areas through the plateau.

(*c*) Lake Chad, on the east, is a shallow swampy area representing the final stages of the silting up and filling in of a huge inland basin.

(*d*) There is an extensive area of coastal lowlands, often mangrove fringed (see Figure 33) which widens out in the Senegal region to form one of the few large lowlands in Africa.

(*e*) The Low Plateau frequently ends in abrupt scarps overlooking the coastal lowlands and making penetration of the interior somewhat difficult.

**3. Climate and vegetation.** The whole region is inter-tropical and therefore experiences various forms of tropical climate. As Figure 15 shows, the rainfall decreases more or less regularly northwards from the south and south-east, i.e., from the coast to the inland. This results in a parallel east to west zonation of rainfall and vegetation types ranging from high rainfalls and forests on the coasts to desert rainfalls and xerophytic scrub vegetation on the farther inland areas. The area has the highest annual rainfalls in Africa in the Cameroons (up to 400 inches a year) and Sierra Leone (up to 175 inches a year; see Figure 20). Both these totals are the result of orographical rainfall.

Figure 33 shows the basic vegetation zoning of the area. Several points are worth noting:

(*a*) The mangrove swamps and forests fringing the foreshores of much of the land were a great hindrance to early penetration from the sea.

(*b*) The regular zoning of forest, woodland, savanna grassland, thorn scrub and desert associations.

(*c*) The map does not show the very important controlling factor of the tsetse fly in the denser woodland areas. This has a marked effect on the settlement pattern and distribution of domestic animals.

**4. Economic development and land use.** Figure 34 indicates the broad zones into which the area may be subdivided. These are obviously related to climate and vegetation factors except for Number 5 region. West Africa generally is a country of poor resources. It is a land of rather difficult physical conditions, where the marked summer rainfall and long winter drought (see Lamy, Timbuktu, Kayes, Bouake and Freetown graphs on Figure 20) create special problems for agricultural development. Much

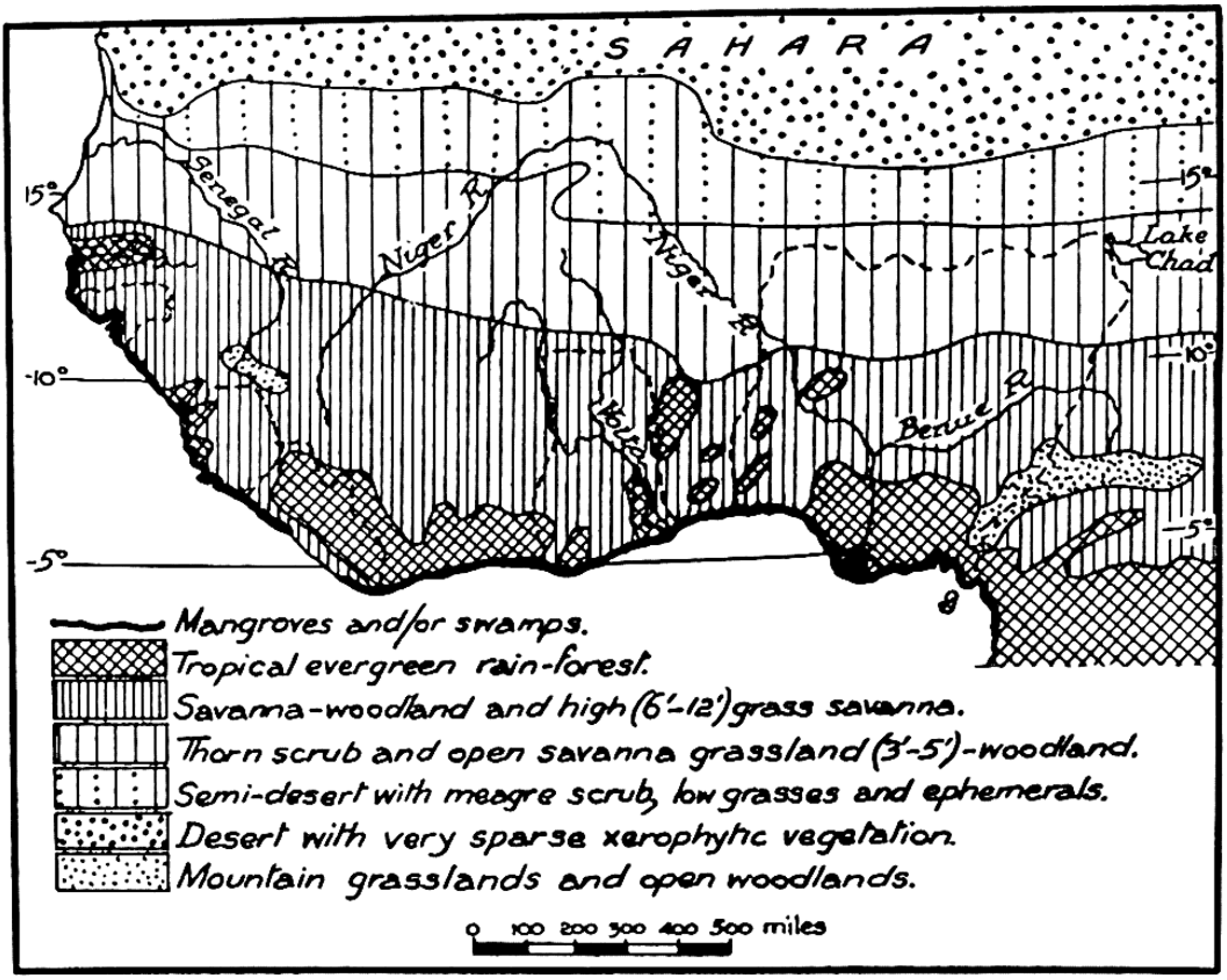


FIG. 33. *Vegetation zones of West Africa.*

research into the conditions of soils, vegetation and climate and into the resources of labour, minerals and water needs to be done before any large-scale development can be attempted.

At present the economy is based on native agriculture, with the hoe as the principal implement and the growth of a limited number of crops for subsistence living. There has been some spectacular development of certain commercial crops such as cacao (cocoa) and ground nuts (peanuts), but the simple village agriculturist or herder is still the principal farming type throughout the two million square miles of this land.

The text, shading and symbols on Figure 34 show the principal economic features of West Africa and it will be sufficient here to comment briefly on them:

(*a*) *Number 1 region* along the coastlands has generally shown the greatest agricultural development. It has the highest rainfalls, is more readily accessible by outside trading peoples, and can produce more crop products in demand by European peoples. Some plantation cultivation is found here, but the bulk of the principal export crops (cacao, oil-palm, bananas and kola nuts) is in the hands of native farmers, native gatherers and native traders.

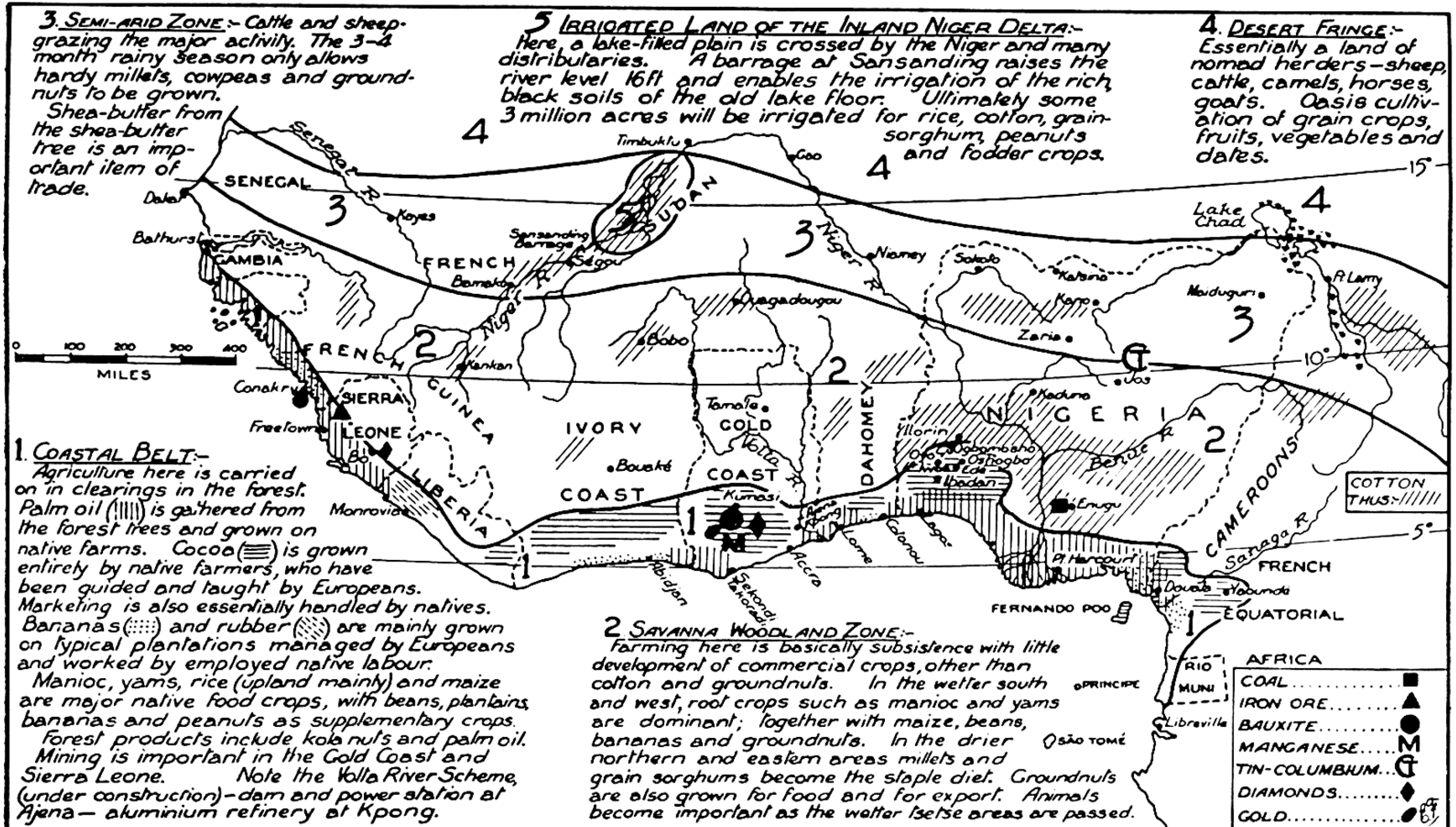


FIG. 34. *Major geographic regions of West Africa and a map-summary of their geographical features.*

Minerals, too, are of considerable importance in parts of the sub-region. The Gold Coast manganese, gold, bauxite and diamonds and the Sierra Leone and French Guinea bauxite and iron ore are quarried and exported in considerable amounts. The bauxite of the Gold Coast is very high grade ore and is present in such large quantities that it is proposed to smelt it locally with electric power provided by the Volta River scheme. This scheme is now under construction and when finished the dam will be larger than the Hoover Dam in Colorado and will supply water for irrigation and for hydro-electric power to be used in the general industrial development of southern Gold Coast.

Much of the Guinea Coast is fringed by deep lagoons separated from the sea by mangrove-covered mud banks. Shipping facilities are being improved by cutting canals through the outer mud banks and constructing ports on the sheltered water of the lagoon. This has been done at Abidjan, Sekondi, Takoradi and Lagos. Its importance lies in doing away with the need to unload ships off-shore into surf-boats which then land the cargoes on an exposed coast.

(*b*) *Number 2 region* on Figure 34 is the savanna woodland zone. It is widely infested with tsetse fly and this limits the keeping of animals. Except for some commercial cotton growing in Nigeria and ground nuts in French Guinea, the farming here is essentially the traditional Negro hoe cultivation of subsistence crops.

(*c*) *Number 3 region* is a nomad pastoral area with subsistence crop farming on wetter areas. Ground nuts are grown commercially in Senegal and cotton in northern Nigeria. Shea-butter is an important item of internal trade, as it is used as a substitute for fats in cooking and eating.

(*d*) *Number 4 region* is a nomad area with limited oasis cultivation.

(*e*) *Number 5 region* covers the Upper Niger Delta. This is an old lake-filled plain now traversed by many distributaries of the Niger River. By building a barrage at Sansanding on the upper end of the area, the French have promoted irrigated farming. Though results are below expectations, cotton, rice, ground nuts and native food crops are being grown.

Throughout this area there is a much better relationship between Europeans and natives than in the other parts of Africa. Here the white invaders and conquerors have been largely content to administer and to leave the farming to the native inhabitants. At the same time they have helped the native to develop valuable commercial crops, which have added greatly to his welfare. In Gold Coast and Nigeria almost complete self-government has been granted to the native peoples, who will ultimately have a status equal to that of other members of the British Commonwealth.

# SECTION II: SOUTH AMERICA



## CHAPTER III

## PHYSICAL FEATURES

### Position and Size

With an area of over seven million square miles South America is the fourth largest of the continents and covers some 14 per cent of the land surface of the globe. Its greatest length is about 4700 miles and the maximum width from east to west is some 3200 miles. The continent extends from 13° N. to 57° S., and in longitude it lies between the meridians of 35° W. and 80°W. From these features of location and size the following important facts are to be noted:

1. The continent extends south 22 degrees farther than Africa and over 14 degrees farther than Australia.

2. It resembles Africa in some respects in shape and length, i.e., in being broadest in the north and tapering towards the south.

3. It lies on both sides of the Equator, but is so arranged that much of its area is in the southern hemisphere. In this way it is somewhat different from Africa, which is roughly symmetrical about the Equator.

4. About half of the length of the land mass is outside the tropics, but because of the tapering shape and the great width from Brazil to Peru, the greater part of the continent—about two-thirds—is inter-tropical.

5. It is almost wholly east of North America, so that its northern regions are actually nearer to south-western Europe than to the well-peopled parts of North America. This has had an important bearing on its discovery, exploration, settlement and later colonisation.

6. On the whole, it is isolated, being bounded on almost all sides by broad oceans.

As we shall see, most of these features are closely related to other important aspects of the historical, physical and economic geography of the continent.

### Physical Structure

Referring to Figures 35 and 36, you will notice that South America, like Africa, is a compact land mass with a regular coastline. There are few projecting peninsulas and a general absence of deeply penetrating gulfs and estuaries. Only on the south-east (the La Plata estuary) and to the north (the Amazon and Magdalena estuaries) are these of import-

ance. From the mouth of the Amazon to the Orinoco delta are many miles of flat marshland. In most parts elsewhere, particularly on the west coast, there are few good harbours or estuaries. This is because much of the coastline has a hinterland of highlands which rise steeply from narrow continental shelves and coastal plains. Only in the far south, in southern Chile, are the coasts very broken, where the sinking of the land drowned

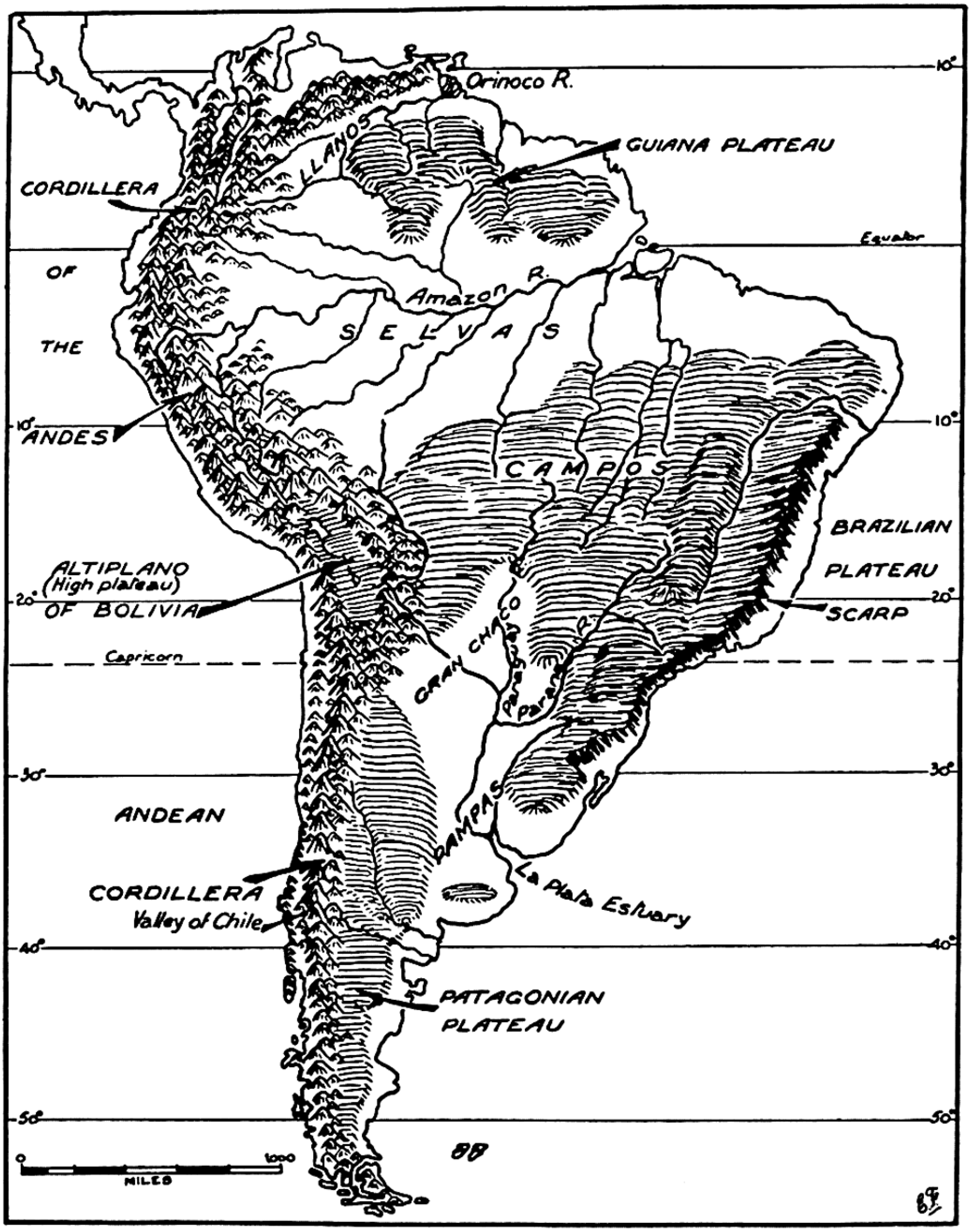


**Fig. 35.** *Generalised sketch-diagram of the main physical features of South America.*

uplands and valleys to produce a fiord coast of long inlets and islands. Several of the best ports in the world are on the east coast, e.g., Rio de Janeiro, El Salvador and Montevideo. On the whole the coastline of South America has been a distinct handicap to the rapid penetration and opening up of the country, especially in its early history. Even today general transport by navigable streams is not easy.

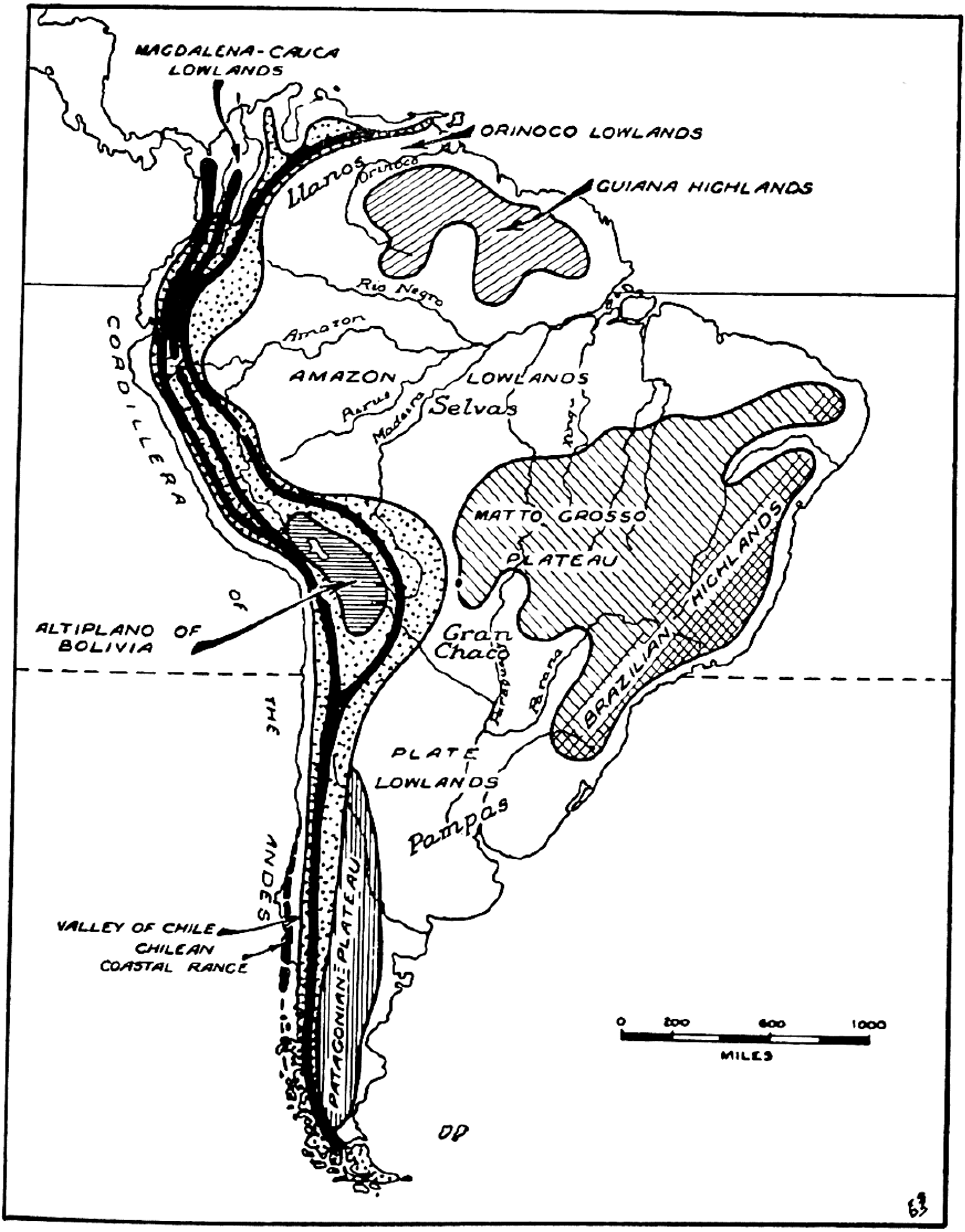


FIG. 36. *Main features of the build of South America.*

The broad pattern and physical structure are simpler than in other continents. You will see by referring to Figures 35 and 36 that there is a relatively simple arrangement of the major landform types into a western fold mountain system, three eastern plateaux and three central lowlands. On these it can be said that the proportion of land over 10,000 feet above sea-level is greater than in any other continent, while the proportion of lowland is greater than any other continent except Europe.

**1. The Andes.** The most striking physical feature is the western cordillera of the Andes, one of the most impressive mountain systems in the world. It extends the whole length of the continent, a distance of some 6500 miles, from Trinidad to the Straits of Magellan. The greatest width is 400 miles, in Bolivia, while the average height is 13,000 feet. Actually the Andes are rarely a single chain, but are made up of a series of long parallel ranges of fold mountains. They are believed to have been pushed up slowly by lateral pressure from the west brought about by the sinking of the Pacific Ocean floor. It is estimated that by these giant waves the earth's crust has been lifted by folding and faulting to some 30,000 feet above the ocean bed. Such an origin is suggested by the presence of limestone rocks of marine origin on high mountain peaks, while their great height and lack of much erosion show the uplift to have occurred in recent geological history (Oligocene-Miocene mountain storm; see Figure 8). The crustal movement has produced lines of weakness so that earthquake shocks are frequent and many volcanoes have developed on the tops of the ranges. These appear as great snow-capped cones, some of the most famous of which are Aconcagua (the loftiest peak in the continent) and Chimborazo. These are extinct, but Cotopaxi (see Figure 37) is regarded as the highest active volcano in the world.

Figures 36 and 37 show that often three roughly parallel ranges occur. These consist of a lower coastal range on the west separated by a long deep valley from the central range, and this in turn is parted by a high plateau region from the eastern ridge. Such flat uplands at high altitudes are often called intermontane plateaux. The Spaniards as the first European explorers and settlers gave a number of names from their language to the physical features. Thus on their old maps they drew the ranges like rope or cord and so gave them the name of "cordillera". The sharp peaks of the mountains came to be known as the "sierra", which means a saw. Where the ranges met in great complex clusters or "tied" ridges the name "knots" was applied. Then the great valleys or canyons eroded by streams were spoken of as the "pongas".

While these are the major features of the Andes, their structure and character vary widely from one region to another. To understand this fully it is necessary to look at the three major subdivisions, i.e., the Northern, Central and Southern Andes. (Reference to Figure 37 will help you to follow the next section.)

(*a*) *The Northern Andes* run from just south of the Equator to the Caribbean Sea. Beginning as a knot, the Loja, they fan out into two

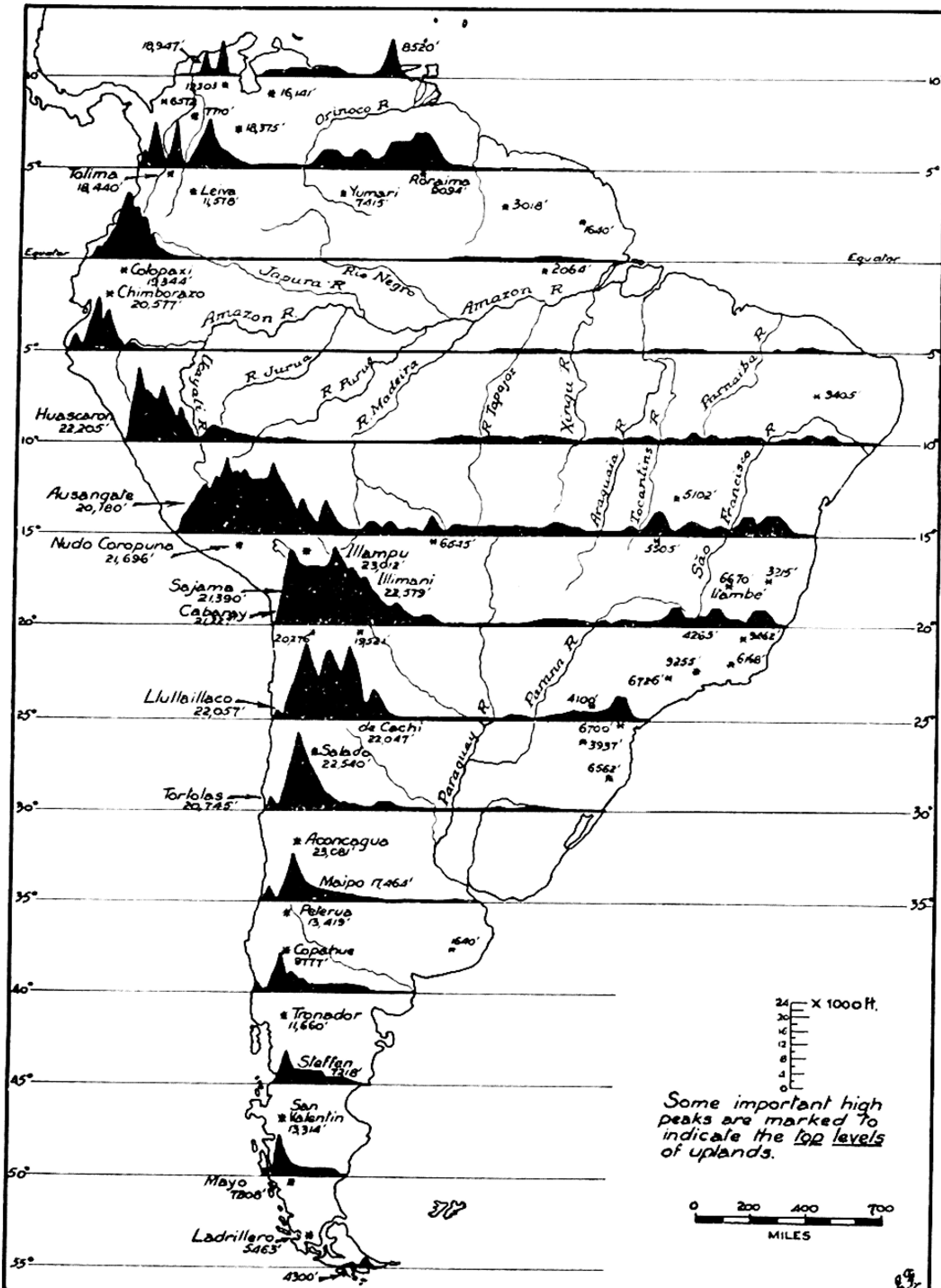


FIG. 37. *Pattern of the main rivers of South America and sections across the continent at intervals of five degrees of latitude.*

ridges to envelop the Quito Plateau before converging again in the Pasto knot. From here the ranges northwards open out finger-like to form three distinct chains with deep longitudinal valleys. In these are the northward-flowing Magdalena River and its main tributary, the Cauca. The most easterly range, the Cordillera Oriental, then divides into two lines to enclose the Maracaibo Basin. A continuation follows the coast, passing through Venezuela and out to sea into the island of Trinidad. Evidence of the further projection of the Andean structure into the Caribbean can be seen in the chain of islands forming the Greater and Lesser Antilles of the West Indies.

(*b*) *The Central Andes* are possibly the most complex of the whole system, being made up of a series of ranges, enclosed basins, deep incised river valleys, knots and volcanoes. Beginning from the knot of Loja, three large ranges, in the deep valleys of which rise two important tributaries of the upper Amazon, run south to meet again at the knot of Pasco. They then continue as two of the highest chains in the continent (over 20,000 feet) and include the extinct volcano of Illimani (22,000 feet). Widening out to a distance of over 400 miles, the ranges now encircle the high plateau or "Altiplano" of Bolivia and southern Peru. This intermontane basin is situated at a height of 12,600 feet and contains Lake Titicaca. With an area of 3000 square miles, this is still a large body of water, but it is only a remnant of a former vast lake. It is now gradually disappearing by evaporation, since the plateau itself is an area of inland drainage with a generally arid climate.

(*c*) *The Southern Andes* proceed south from here, but become simpler in structure and lower in altitude than the central and northern regions of the system. They consist mainly of one major eastern chain and a series of low coastal ranges. The most significant of these is that of central Chile, and between it and the main cordillera lies the long and important valley of that republic. In the far south the mountains have been partly drowned and heavily glaciated, some high valleys still being filled with glaciers. Much of it is typical fiord scenery, with many islands, archipelagos and steep winding inlets and straits, of which the Magellan is the best known. Two other special features of the Southern Andes are Aconcagua (22,830 feet) the highest peak in the two Americas and the high railway pass of Uspallata (12,000 feet), joining Chile and Argentina.

Apart from their purely physical aspects, the Andean Cordilleras play other important parts in the geography of South America. Thus for example:

(*a*) They form a great watershed between the rivers which flow to the Atlantic and Pacific oceans. But the divide is such that while great rivers like the Amazon rise within 100 miles of the Pacific, they are forced by the position of the mountains to flow some 3000 miles to the Atlantic Ocean. On the other hand, there is not one significant stream on the western side.

(*b*) They divide the continent climatically into two distinct regions, a wide one affected chiefly from the Atlantic and a narrow one open to Pacific influence. At the same time, their great height and length provide many marked local contrasts. Naturally, this fact has in turn affected the vertical zonation of vegetation and land use. Details of these features will be seen later in Figure 41.

(*c*) The great mineral wealth in certain regions has attracted large mining and developmental companies. But these areas are strictly localised and difficult of access.

(*d*) They have always proved barriers to penetration and the development of transport systems. Cost of transport from the uplands to the Pacific is almost prohibitive, and so the great potentialities of republics like Colombia, Peru and Bolivia have hardly been realised after centuries of occupation by western peoples. Even on the actual plateau surfaces, roads are often little better than steep narrow tracks on which horses, mules and the native llama are used both for travelling and for carrying goods.

**2. The Main Plateau areas,** as distinct from the intermontane highlands of the Andes, include regions in Guiana and Brazil. These are the remnants of a very ancient mountain system which was in existence many millions of years before the rise of the Andes. Actually they seem to have provided the hard old blocks against which the cordilleras were buckled by pressure from the west. Note the manner in which the mountain ranges swing around in a great curve north of the Guiana Highlands (Figure 36). We can see here some resemblance to the ancient plateau of the Deccan of India, Yunnan, Western Australia and Africa. Some believe it possible that all these uplands, including those of South America, were joined together in an early geological period, making up one huge southern continent known as Gondwanaland.

Today the Guiana and Brazilian highlands are still extensive in character and vary from 3000 to 5000 feet in height, but their horizontal strata of sandstones resting upon old crystalline rocks have been so dissected by erosion and fractured by faulting as to provide varying types of scenery. In some areas the dissection has been so great that the country appears as an irregular series of rounded hills and ridges divided by deep ravines. In other parts there are numerous tablelands with steep scarps separated by wide open valleys. Here erosion has been very marked and the sandstones have disappeared completely.

While the two plateaux have certain similarities in age and origin, there is a break between them, occupied by the Amazon River and its tributaries. The special characteristics of each are worth noting because they have had much to do with their development.

(*a*) *The Brazilian region* takes up about one-quarter of the Republic of Brazil and can be seen as a large land block with a short steep scarp facing the South Atlantic Ocean and a long gradual slope inland. Near the coast the uplands reach a height of over 8000 feet and have been so

eroded as to appear in the south-east as a mountain range called the Serro do Mar (Mountain of the Sea). The coastal margin here is narrow and rugged, but has a number of fine harbours of which the best-known is the breached volcano crater at Rio de Janeiro. To the west the highlands fall away as a series of terraced tablelands surrounded by hilly country to the plains of the Amazon and the Parana-Paraguay. The tributaries of these streams are navigable into much of the plateau, but the watershed between the two systems is provided by the higher regions of the Mato Grosso or "Great Woods". The one large stream which does flow into the Atlantic is the Sao Francisco and some of its upper course is navigable.

A considerable area of these particular highlands lies within the tropics, and their height modifies the climate. This fact, together with suitable soils in certain areas, helps to provide the background for a wide range of agriculture. Mineral wealth in the ancient rocks is now providing the basis for considerable industrial activity. The possibilities of development here and on the coastal plains have attracted many European migrants in recent years.

(*b*) *The Guiana Highlands* also reach to 9000 feet, but their highest areas are well inland and are very rugged; they consist of the ridge and valley topography, formed by ancient mountain remnants projecting through a plateau surface. It is this area, too, which forms the watershed between the Orinoco and Amazon tributaries. As these uplands fall towards the wide coastal plains of the east in a series of tablelands with steep flanking scarps the streams there have developed many high waterfalls and extensive rapids. These difficult courses have made them almost useless for navigation. Such features, the tropical climate, the dense forests and distance from the sea help to explain why even today much of the Guiana uplands are little known and developed (see Figure 50).

(*c*) *Minor plateau regions* include those of the western portion of the Gran Chaco ("Great Hunting Ground") and the southern part of Argentina. Actually they are both part of the eastern flanks of the Andean Cordillera, with the Patagonian area (in the south) the more extensive and rising to an average height of 3000 feet. Although its rocks are a mixture of very old types, lavas and silts, much of its surface has developed into shingle desert. The flat surface generally is barren and windswept, but several rivers falling to the Atlantic have developed deep valleys, in which the pastoral farming of sheep has been most successful.

**3. The lowlands and drainage pattern.** As Figure 36 shows, extensive areas of lowland plain stretch north and south through roughly the centre of the continent. Their present site was occupied in former geological times by an ancient sea which separated the eastern plateaux from the western mountains, but it was gradually filled in by rivers bringing down rock waste from the surrounding uplands. This helps to explain several general features of the lowland regions, although in detail they vary significantly:

(*a*) Their general flatness with very little relief and an altitude of less than 1000 feet as they slope gradually back to the high land.

(*b*) Their common geological background, consisting as they do of sea-beds overlain by deep alluvial deposits from rivers. These silts are being added to from time to time by vast floods from the main streams which have also built up great deltas at their mouths.

(*c*) The present drainage pattern of the continent, for, together with the features mentioned above, the almost universal slope of the lowlands from the coast inland (see Figure 37) has helped to develop the three great river systems of the Orinoco, Amazon and Parana-Paraguay.

(*a*) *The Orinoco Basin.* Figure 36 shows the Orinoco River, with a length of some 1500 miles, to have its source in the south-west of the Guiana Plateau. It flows around the western and northern side of these uplands and enters the sea by a series of channels or distributaries and a great delta. It will be seen therefore, that much of the basin actually lies between the Andes Mountains and the highlands from which come several tributaries. There is only a very low divide between this basin and that of the Amazon; and in one point the Casiquiare River actually links the Orinoco with the Rio Negro (a tributary of the Amazon). The main stream is navigable for over 500 miles by river steamers, but the presence of the delta and rapids, as well as shallow water for many months of the year, makes regular commercial transport impossible. The total area of the basin is some 120,000 square miles, and as much of it is covered with tall grasses and scattered trees, it is termed savanna land or the "Llanos". This is a region of considerable beef-cattle raising, but the industry and scattered population suffer extreme seasons of heavy rain, great heat and floods alternating with parching droughts and hot winds. As a result of these factors and transport difficulties, the pastoral industry has declined in recent times.

(*b*) *The Amazon River.* The drainage basin of the Amazon is of great area, being roughly five-sixths the size of Australia and gathering water from two-fifths of the continent. Rising on the eastern flank of the Andes at a distance of only 150 miles from the Pacific Coast, it flows eastwards for nearly 4000 miles to the Atlantic Ocean. At its mouth there is an estuary over 50 miles wide and the large delta island of Marajo is as big as Scotland. The snow-fed headwaters and frequent equatorial rains have developed many large tributaries in well-defined valleys. The main stream itself, flowing through a wide flat plain, has innumerable channels, islands and marshlands. Although drier seasons occur during the year, the navigability of the Amazon is remarkable. Large ships can steam 1000 miles up its course to Manaus and smaller vessels can go another 1700 miles to Iquitos. Because of the great heat and moisture, most of the basin is covered with dense equatorial jungle, generally referred to as the "Selvas". In some parts are vast areas of marshland, and altogether much of the region is unexplored, undeveloped and unin-

habited (see Figure 46). The main inhabitants are Indians, who hunt and fish and practise shifting cultivation. In the lower course are a few scattered plantations of cultivated rubber, sugar and cacao (cocoa). Hardwood timbers of special value are also obtained.

(*c*) *The Parana-Paraguay Basin.* This is an extensive area of about a million square miles with only a low divide between it and the Amazon Basin. For the most part it consists of flat featureless plains, which, except for the southern part, are drained by the major stream, the Parana, and its chief tributary, the Paraguay. The lower course is a broad shallow estuary referred to as the Rio de La Plata and it is gradually being filled in by the great masses of sediment deposited by the streams. The Parana is recognised as being larger and longer than the Mississippi and both it and the Paraguay are navigable for hundreds of miles. Although the northern portion of the plains lies within the tropics, providing a difficult scrub-forest country called the "Gran Chaco", the cooler parts are being developed by immigrants. They have found the climate, soil and ease of transport suitable to both arable and pastoral agriculture, but it is the more temperate and shorter grass plains of the "Pampas" (Spanish for vast treeless plains—the Pampa of Argentina is a specific example) which have become economically the most significant region of the continent. There are quite a number of facts responsible for this, the most important of which are the fertility of the soil, the great extent of level grasslands, the temperate climate, the ease of rail and water transport, and the presence of excellent city sites and ports. Thus it is one of the great grain and animal raising centres of the world, extending from Argentina into Paraguay, Uruguay and Brazil. Because of its special importance we shall study it in more detail later (Figures 53 and 56).

Apart from these major features of the drainage pattern, there are several other aspects to be noted on the maps. For example, it will be seen that since the Andes Mountains form the main watershed, their location results in short rapid streams on much of the Pacific side. Supplied with considerable snow water, these form the basis for much irrigation in dry regions and often break through the coast ranges in deep gorges in order to reach the ocean. Again, it will be noted that some streams flow for long distances in the deep longitudinal valleys of the mountains. Then they may reach the sea directly to the north, as in the case of the Magdalena and Cauca, or they may have to break through deep gorges to the inland plains, like the upper reaches of the Amazon. Finally, on the Brazilian Plateau there are several northward-flowing tributaries to the Amazon, but one stream, the Sao Francisco, rises near the eastern edge of the highlands and flows almost parallel to it for many miles before turning east to reach the Atlantic coast through the scarp.

Although the rivers of South America were important in providing entry to the continent in the early days of exploration and settlement (see Figure 47) they are not on the whole of great value as commercial waterways today.

# CHAPTER IX

# CLIMATE AND VEGETATION OF SOUTH AMERICA

In studying the climate of South America it would be well for us to refer first to what we studied in Chapter II concerning the seasonal movement of the sun and its relationship to the development of pressure belts, wind systems and rainfall. Then it will be easier for us to see how these might apply to South America, bearing in mind its latitudinal position, its shape and structure. Thus, for example, the wide portion of the continent in the north is situated within the tropics, with the Equator roughly bisecting it. As a result, much of this large area has what we might call an equable climate, because of the constantly high temperatures, small changes in the length of day and heavy convectional rains. Next, the tapering shape into high latitudes brings the extra-tropical regions under the oceanic influences of both the Atlantic and the Pacific as well as the constant and seasonal movements of the major wind streams. Thus, here again is an equability of climate with no great ranges of temperature. Actually it can be said that in no other continent have lands in the same latitude such small ranges of temperature as occur in the more favoured parts of Argentina and Patagonia. Only within the cordillera regions do extremes occur, for here the height and the enclosed nature of the plateau basins produce very cold conditions and low rainfall, with many local variations.

## Rainfall

One of the major features of South America's climate, which reflects closely its position, shape and structure, is the rainfall. If we examine Figure 38, at the same time bearing in mind what we saw in the maps dealing with physical features, we can note the following general aspects about the annual and seasonal rainfall.

There is heavy rainfall on the slopes of those uplands which face the Atlantic Ocean, across which move the constant north-east and south-east trade winds. These places include the south-eastern edge of the plateau of Brazil and the coastland of Amazonia and Guiana. On the Pacific coast of Colombia local south-westerly winds produce rainy conditions all the year, and the monsoon climate here is not unlike that of the Guinea Coast of West Africa. Wind streams from the west also bring a heavy rainfall to the mountain lands of southern Chile. In the Amazon Basin, penetrating trade winds, high evaporation and convection cause

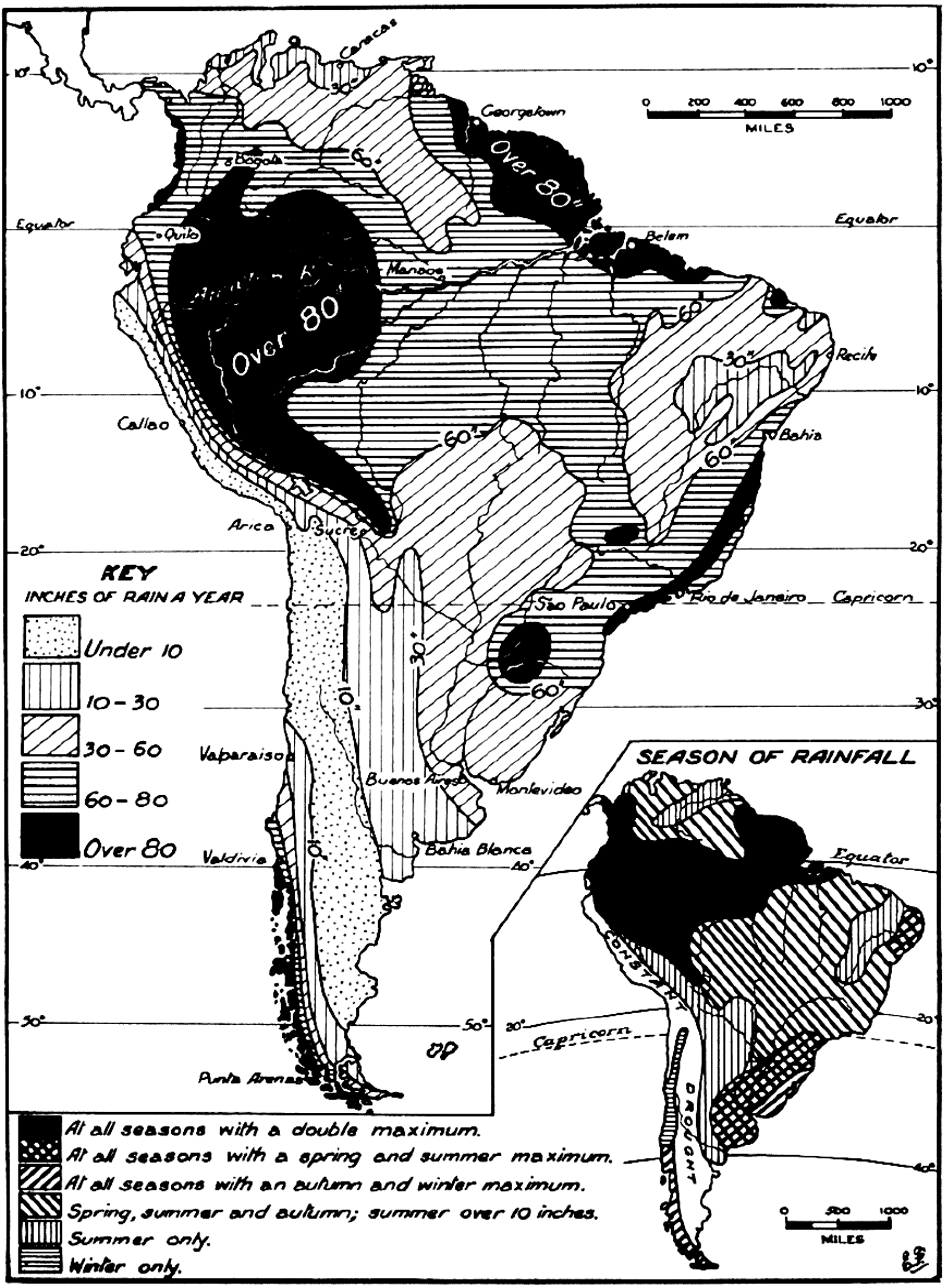


**Fig. 38.** *Annual rainfall and seasonal distribution of rainfall in South America.*

heavy rain almost daily, usually in the afternoons, when equatorial storms of great intensity develop. The occurrence of the double maximum precipitation within the low latitudes can be attributed mainly to the swing of the equatorial rain belt as it follows the seasonal march of the sun. A striking example of this can be seen by reference to the pillar graph for Iquitos on the upper Amazon (see Figure 39). Also closely affected by this factor are the tropical regions lying north and south of the Amazon Basin itself. The periodic shifting of trade winds accounts mainly for the seasonal maxima of north-eastern and south-eastern Brazil as well as of the Uruguay-Argentina regions. In the case of central Chile the strong wet westerlies appear only in the winter season, reaching as far north as 35° S. Summer rains in the Orinoco Basin and north-eastern Brazil are associated with intensified tropical conditions and penetrating on-shore trades. In western Argentina and Paraguay there is a summer maximum, but it is relatively low in amount because of the diminished effect of the wind systems. Finally, the regions of low rainfall are determined generally by uplands forming wind barriers and so producing a series of rain shadow areas. These are typical in Patagonia, which receives strong cold and dry air currents from the west after crossing the Andean Cordillera. An extension of this region of almost constant drought is found in northern Chile and southern Peru, where the Andes again block the rain-bearing south-east trades. In parts of north-east Brazil, a dry zone results from its not being reached effectively by either trade-wind streams. The high Andean plateaux in Peru and Bolivia get little rain or snow because of the higher ranges on their flanks.

## Climatic Regions and Vegetation Types

These main points about the rainfall of South America should now help us to appreciate the general pattern and some details of the chief climatic types of the continent. Referring to Figure 39, it will be seen that only the larger and simpler climatic divisions are shown. In a country so large and diversified, we could expect many and complex features relating to its climate. Again, it can be seen that there is a general symmetry in the arrangement of the types on either side of the Equator and with reference to the continental east and west coasts; it is well worth comparing and contrasting this kind of pattern with that of Africa. In a later part of our studies, we shall be struck by the way in which the climatic circumstances west of the Andes are similar to those in North America. Thus they show roughly the same succession of west coast humid cool temperate types, followed by a Mediterranean area of winter rain and finally a desert zone.

There is also a striking relationship between the patterns of climate and vegetation, as we can see by briefly examining Figures 39 and 40 together. For example, we can see a marked development of great forests associated with equatorial and tropical conditions. Savannas also appear

in the lower latitudes, while prairies occur in the more temperate mid-latitudes. Possibly the most striking association is that of the great Andean Cordillera, where altitude and large areas of plateau have produced plant types with little or no relation to those of the neighbouring lowlands. All this we shall discuss at greater length in the next section of our work and in later detailed studies of various regions. For the moment we must bear in mind that climate is always the most important element in our environment. It determines in a large measure the exploration, settlement and development of a land. This has been so in South America, particularly where the challenge of climate, together with landforms and vegetation has been so great, that neither the aboriginal nor the later European inhabitants have effected any great change to the continent as a whole, which still appears much as Nature made it.

**1. Equatorial hot-wet type** (Number 1, Figure 39). This is experienced in the regions of high temperature, humidity and rainfall all the year. As the rainfall graphs show, there is no really dry season but rather periods of heavy rains, as in similar regions in Africa. In Iquitos there is the convectional type of rain, but in the cases of Belem and Georgetown the seasonal character of on-shore winds is an important factor. Other places with this climate, besides the central Amazon, are the coastal lowlands of the Gulf of Guayaquil and part of south-east Brazil—marked 1(a) on the map—where latitude modifies temperature and a high rainfall results from the highlands forcing upwards the moisture-bearing air currents from the sea.

*Vegetation* (Number 1, Figure 40). This climate produces the "Selvas", the world's most luxuriant forest. There is a great variety of broadleaved evergreen trees. Rising to enormous heights and growing a dense continuous foliage, they obscure the ground and prevent the development of undergrowth. Only in certain parts, as on the banks of streams and mountain slopes where the sun can penerate, is there the true dense jungle. The parts where the forests are not so dense are along the upper waters of the Parana and Paraguay rivers. In such an environment few animals live on the ground. Most have taken to the overhead tree cover, which provides food for innumerable monkeys, snakes, birds and insects. Many types of plants have commercial value, e.g., the palms, rubber, banana and cacao. Their cultivation is made difficult by the enervating climate, disease and poor transport. Lumbering is backward because the trees are difficult of access, although this is the world's untapped source of hardwood timbers like mahogany. Apart from several cities developed by Europeans as river transport and trade centres, much of the population is still made up of Indians engaged in shifting cultivation.

**2. Tropical continental wet type** (Number 2, Figure 39). This particular type is seen to lie on either side of the Equator, being marginal to the regions just discussed above. Study of the rain graphs for Caracas (coastal)

and Cuiaba (inland) shows a very definite dry season in the local "winter", but a high rainfall in summer, because the high temperatures resulting from the heating up of land at that season cause rising air currents and an inflow of Atlantic sea winds. Droughts are liable to occur in the rest of the year.

*Vegetation* (Numbers 2 and 3, Figure 40). As a result of these conditions areas like the Guiana highlands and the Orinoco lowlands in the north and the Brazilian uplands in the east have a vegetation of open forest and woodland near the rain forest. These gradually change with distance into great expanses of tall grasses, growing in tufts, with bushes and stunted trees mainly along the watercourses and in higher rainfall areas. In the Orinoco region they form the "Llanos", while in Brazil they are named the "Campos". These grasslands have long been used for beef-cattle ranching, but many difficulties in transport, settlement and breeding of stock have left them with only a small scattered population. A southern extension of a similar type of vegetation is Number 4 on Figure 40, which is seen as a broad strip situated between the foothills of the Andes Mountains and the Paraguay River. Heavy summer rains cause floods and leave swamps; but during much of the year it is dry, the most arid portion being the "Chaco" (hunting ground). Apart from cattle-raising and some growing of cotton and tobacco, it is famous for the quebracho tree, from which tanning extract is made. A similar dry area is to be noted along the Sao Francisco valley of north-east Brazil.

**3. East coast humid warm temperate type** (Number 3, Figure 39). This climate extends from the coastal regions of southern Brazil across much of central Argentina, including the estuarine lands of the La Plata. Rainfall is steady all the year, but, as the contrasting graphs of Montevideo (coastal) and Ascuncion (inland) show, there is more of a summer maximum in the latter. Winters are mild and the summers warm to hot.

*Vegetation* (Number 6, Figure 40). In this climate are the famous "Pampas". Its grasses grow to a maximum height of eight feet. Since the land is very flat, they appear as an unbroken expanse, changing colour with the seasons: green in spring, white in autumn, and brown in summer. The only trees are those appearing as canopies along and over the streams and called "galeria" (or tunnel forests). Such grasslands, together with the climate, have favoured extensive cattle-raising and grain-crop cultivation, so that today they are one of the greatest regions of their kind in the world. It can be compared with similar places in south-east Australia and central North America.

**4. Warm temperate winter-rain type** (Number 4, Figure 39). This type occurs on the coastland of middle Chile. There are mild rainy winters, as the permanent belt of westerly winds in higher latitudes moves northwards at that time. The graph for Valparaiso shows this seasonal character of the precipitation and the dry summers. Inland are cool areas

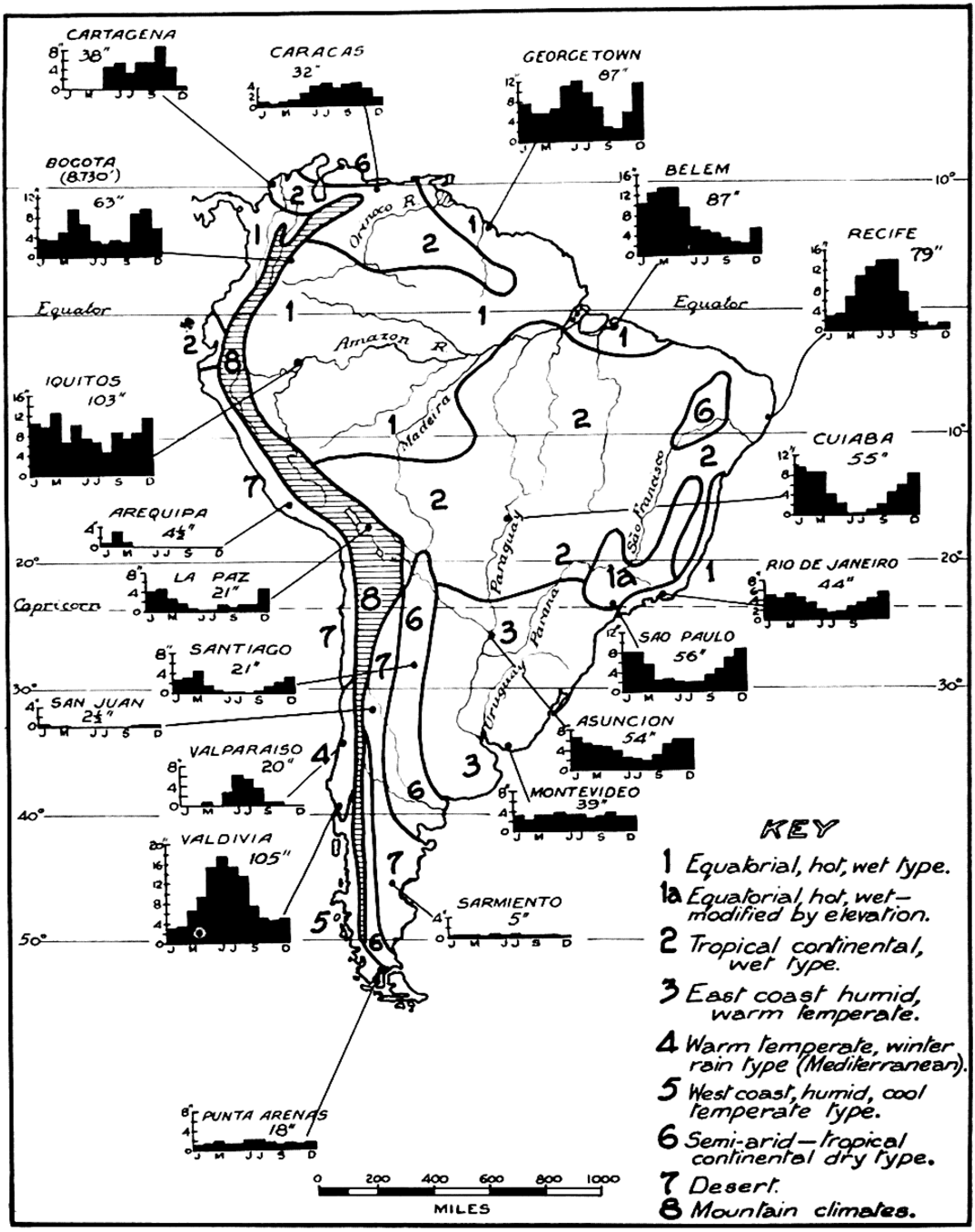


FIG. 39. *Principal climatic regions of South America, with rainfall graphs of selected towns to show the pattern of rainfall over the continent.*

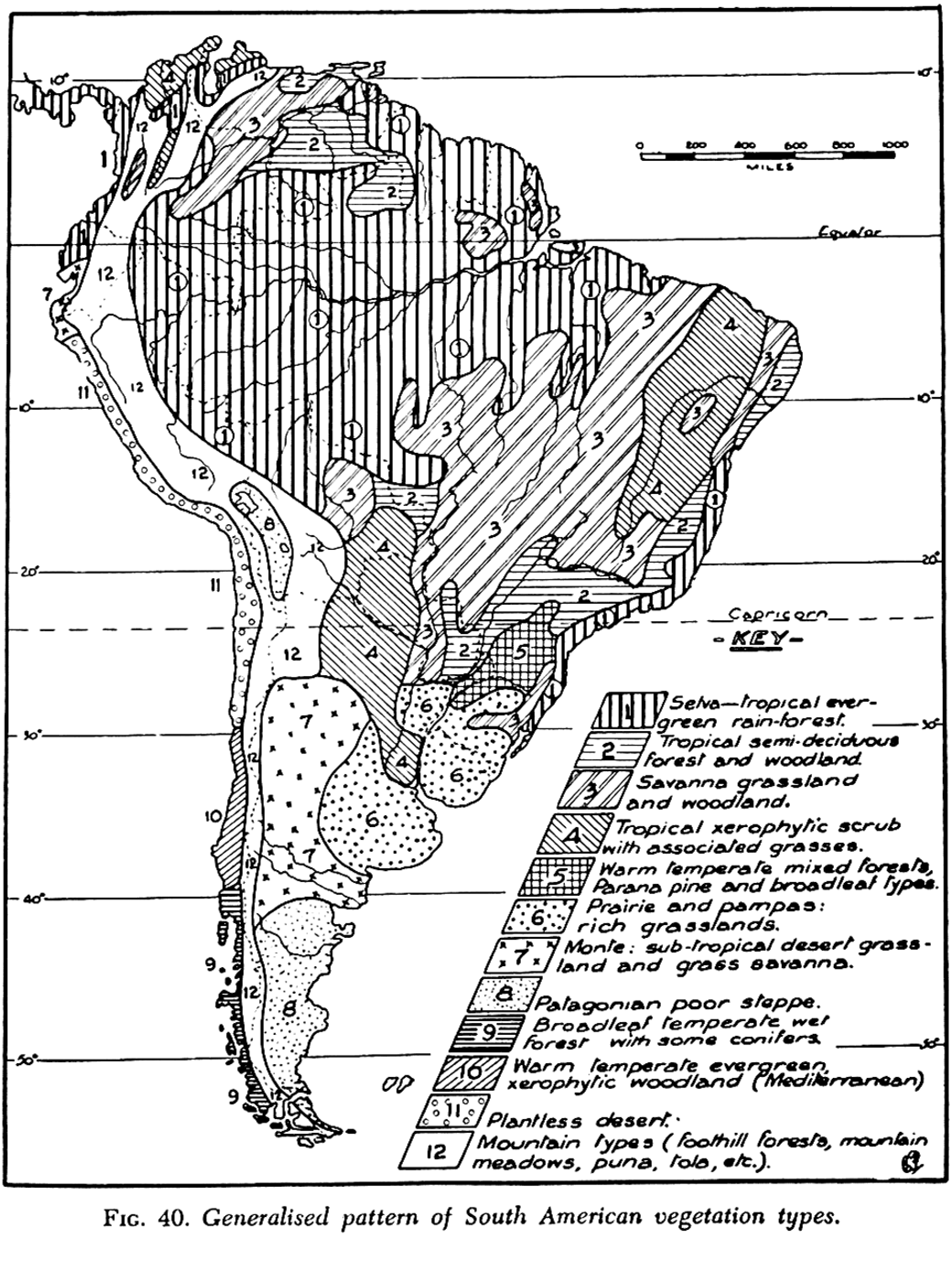


FIG. 40. *Generalised pattern of South American vegetation types.*

because of the altitude of the Central Valley. This feature makes it different from other places in the world having such a Mediterranean climate because summers there are generally hot, e.g., Cape Province, California and south-west Western Australia.

*Vegetation* (Number 10, Figure 40). Here the vegetation is distinctive, consisting of broadleaved evergreen trees and bushes, such as laurels, cypresses and mimosa. Much of this has been cleared, for the climate and the presence of plenty of water from the nearby uplands for irrigation have made this one of the best-developed areas of South America, specialising in grains, fruits and wines.

**5. West coast humid cool temperate type** (Number 5, Figure 39). On examining the map, we see that this climate is confined entirely to southern Chile. In these high latitudes, which are one of the stormiest in the world, the strong, constant westerly winds ascending the slopes of the steeply rising Andes result in a very heavy rainfall, especially in winter months. This can be seen by reference to the graph for Valdivia, which is on the northern edge of the region. Temperatures are cool and very cold in the far south, the region of many storms.

*Vegetation* (Number 9, Figure 40). Dense forests of evergreen and deciduous trees like pines, beeches and cedars clothe the slopes up to 5000 and 6000 feet. Such vegetation can be contrasted with that of the selvas far to the north, since species are few and undergrowth sparse. The rugged topography, limited amount of cultivable land, and poorly drained soils limit the growth of crops, but livestock are of some importance. Strangely enough there is little lumbering, although much timber is obviously available.

**6. Semi-arid tropical continental dry type** (Number 6, Figure 39). It will be seen on the map that much of the region experiencing this particular climate lies well inland in the lee of the central and southern Andes. Winter westerlies produce a rain shadow in the higher latitudes, while in the tropical area Atlantic influences producing rain are negligible after penerating so far. Except possibly for parts of coastal Patagonia, the precipitation is therefore slight, very variable and unreliable. The graph for Santiago (Argentina) gives some indication of the small amount of rainfall and its tendency to fall in winter months. Actually the summers are warm and winters cool.

*Vegetation* (Numbers 7 and 8, Figure 40). Such climatic conditions favour the growth only of cactus, thorn bush and coarse tussock grasses. Agriculture is confined to cultivation of wheat, maize, flax and cotton along the shifting flood plains of snow-fed streams. Annual flooding of these does not encourage much rural settlement. It should be noted that another strip of this climatic type occurs in the far south, where the permanent westerlies sweep down from the Andes as very cold and dry wind streams.

**7. Desert** (Number 7, Figure 39). The map shows us that there are two desert regions, one on the eastern and the other on the western side of the mountain lands. The eastern desert is a narrow belt of land lying to the west of the area just described above but extending through more degrees of latitude—from the foothills of the Andes, in the tropics, to the Patagonian coast. We could expect a considerable variation of temperature because of its latitudinal range, but its main feature is a very light and uncertain rainfall. Graphs for San Juan and Sarmiento illustrate in a striking way the marked aridity of the region.

*Vegetation* (Numbers 7 and 8, Figure 40). Added to this climatic feature are the porous soils, with gravel and sand on the higher parts greatly dissected into large gorges by streams. Such conditions support only scattered bushes and coarse grasses called "monte". Sheep-raising is possible on the better favoured spots, while irrigation for vines, fruit and alfalfa is practised on the oases along the river valley floors.

The western desert extends along the Pacific Coast for some 30° S. latitude in northern Chile to within a few degrees of the Equator in southern Peru. Actually it is a narrow strip lying between the Coast range and the Andes. As the prevailing winds throughout the year blow from the south-east generally parallel with the western side of the mountains and even down their slopes, they do not bring any rain. In addition the cold Humboldt current immediately off-shore deprives the less frequent westerly and south-westerly air currents of their moisture. What rain does fall is due to local coastal conditions and occasional storms, so that there are few places in the world which are so nearly rainless as this. The graph for Arequipa is a striking illustration of this phenomenon. Temperatures are high and the daily range is great, since with so little rain the clear skies allow rapid gain of heat by day and rapid loss by night.

*Vegetation* (Number 11, Figure 40). In some districts of the desert region of the Atacama of northern Chile, it is so arid that years may elapse between one shower of rain and the next. Hence it is labelled true desert, without a single plant developing there. The only settlement here is that associated with the mining of silver, copper and nitrates and the ports handling them and the produce from the plateaux of the cordillera. The Peruvian Desert has numerous irrigated settlements along the lower courses of streams coming down from the Andes. These have made possible the growing of a great variety of subsistence crops together with the development of some plantation agriculture. This area is illustrated in Figure 49.

**8. Mountain climates** (Number 8, Figure 39). No general statement can be made concerning the climate of the mountain lands. This is because there are many variations in temperature and precipitation due to differences in structure, latitude and altitude, and the exposure to both wind streams and sunlight. For example, temperatures may range from tropical

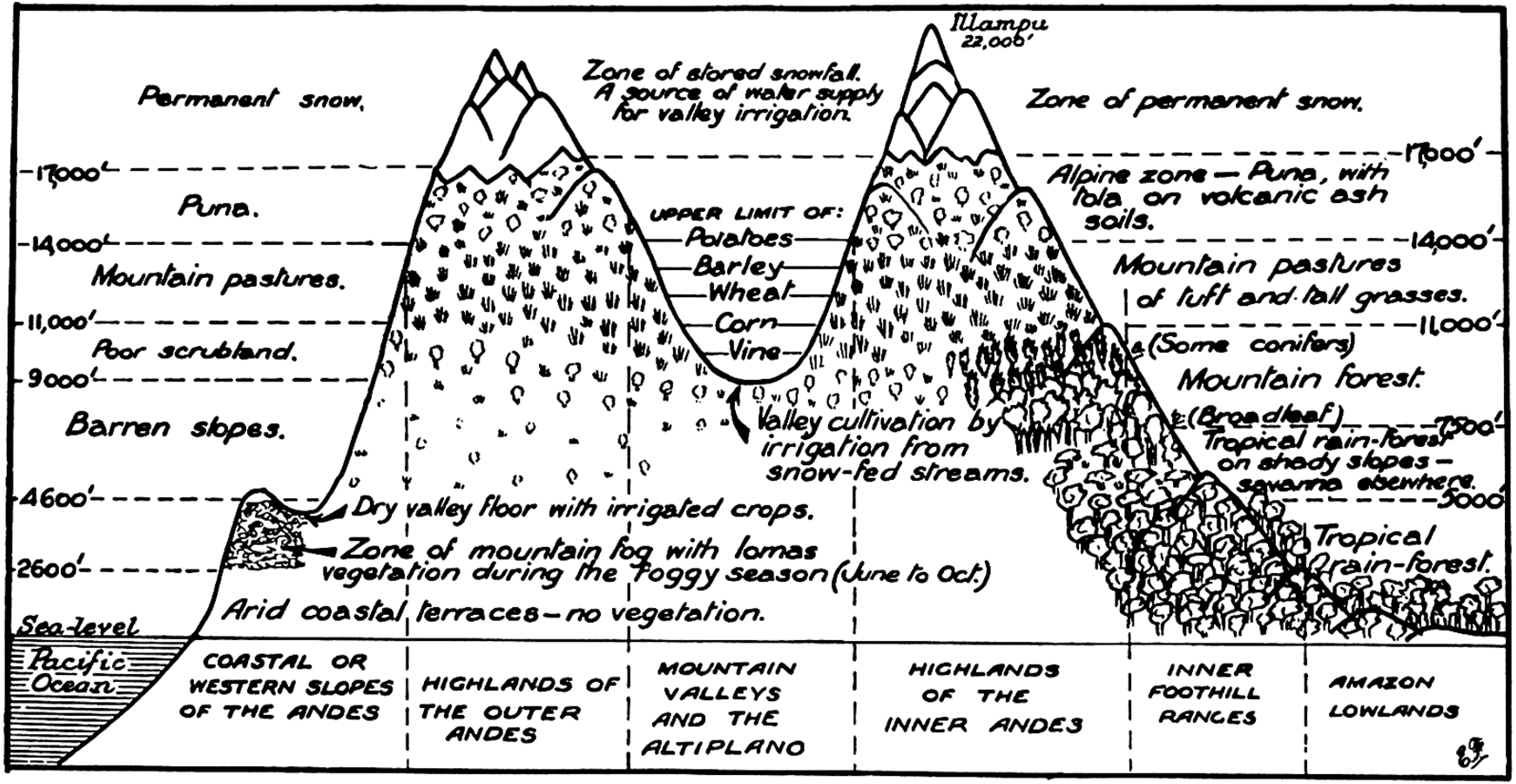


FIG. 41. *Transect diagram across the Andes of southern Peru to show the zoning of vegetation and farming activities with altitude and the differences between the eastern and western Andes.*

in the lower parts to continual frost in the upper ranges. Then precipitation on windward slopes is heavy, with rainfall at lower elevations and snow at higher ones. The high plateau basins are mostly arid.

*Vegetation* (Number 12, Figure 40). Many different types of vegetation occur on the mountain regions, and their pattern of distribution is very complex.

An excellent example of the general relation of vegetation to these mountain lands is to be seen in Figure 41, which shows the zonation of natural vegetation and cultivated crop types according to structure, altitude, and aspect approximately along latitude 20° S. Variations from this particular pattern of zoning would occur at other latitudes, e.g., the zone of permanent snow would be higher towards the Equator and lower towards the poles. On the whole the diagram explains itself, but there are certain features which we might note here. Thus, there are marked contrasts between the vegetation on the eastern and western lower lands—between the "lomas", with its seasonal growth of quick-flowering plants and the dense forest of the selvas. Then there is the contrast up the slopes of the east and the west, the latter having only scrub and pastures to 11,000 feet, while on the former, various types of forest persist to the level of the alpine pastures at about 11,000 feet. We may also note the significance of the permanent snow surrounding the altiplano in providing water for irrigation in this generally rainless area. Finally, the types of crops cultivated and their upper limits are worth studying. We shall learn more about all these aspects when we look at the general geography of the Andes regions of Peru and Ecuador illustrated in Figure 49.

## EXERCISES

1. **Vocabulary words and phrases:** estuary, hinterland, cordillera, sierra, Altiplano, archipelago, fiord, llanos, selvas, campos, pampas, enervating, monte, puna, tola, lomas.

*For the next exercises you will need to consult other text books in the library.*

2. Compare and contrast the physical and climatic geography of the west coast of South America between the Equator and Cape Horn with that of western Africa between the Equator and Cape Town.

3. Describe the changes in landforms, climate and vegetation to be met with on a direct route across South America from Antofagasta (Chile) to Belem (Amazon mouth).

4. Compare and contrast the physical features, climates and vegetation of the Congo and Amazon basins.

5. Describe the vegetation regions of Brazil in some detail and explain briefly the differences noted among the various areas.

6. Using the Amazon selvas as an example, describe the features and animal life of an equatorial rain forest.

# CHAPTER X

# MINERALS

## General Features

In an examination of the mineral map of South America (Figure 42), we may note first certain general features which apply to the continent as a whole. More details will be met with in the studies of the various States and their regional divisions.

There is a marked variety of minerals in the Andean regions, where folding, volcanic activity and erosion have helped both to form and to expose the ores, e.g., in Peru and Bolivia. Particularly sought after were silver and gold in Spanish colonial times, and although there is considerable production of these today, modern industry demands copper, tin, lead, zinc, tungsten and vanadium. In the ancient rocks of the plateaux, increasingly important discoveries are being made of bauxite, iron ore and manganese, e.g., in Brazil and the Guianas. But in most cases there are great difficulties in mining these deposits, although they are of high-grade ores and there is an urgent demand for them. One of the most pressing problems is that of the necessary fuel to help in the processing; South America is lacking in large coal deposits. Recent developments include the opening of a mine for high-grade coal near Cali in Colombia, with the aid of French capital. Exports are to go to Peru and Chile through the port of Buenaventura. A new steel plant is being erected by the Venezuelan Government on the Orinoco River near Puerto Ordaz. It will process ore from the Cerro Bolivar field with the help of hydro-electricity. There is much foreign capital invested in this venture.

Petroleum wells are becoming increasingly important, most of them being on the lowlands, e.g., about Lake Maracaibo. They will do much to assist fuel problems, particularly in relation to transport.

Another striking feature is the strict localisation of the nitrate deposits in the Atacama region, because of the unique circumstances under which they were formed (see Figure 54 and notes). Mining there is continuing, but the exports are not as important as in the earlier years of development.

We might notice, too, the marked contrast between the eastern and western sides of the continent. The latter is highly mineralised, with a large and important world trade; the former has only a couple of localised areas, e.g., Brazil, and exports are relatively negligible.

## Foreign Development of Mining

On the economic side foreign investments have always had much to do with the development of South American minerals. Over recent years

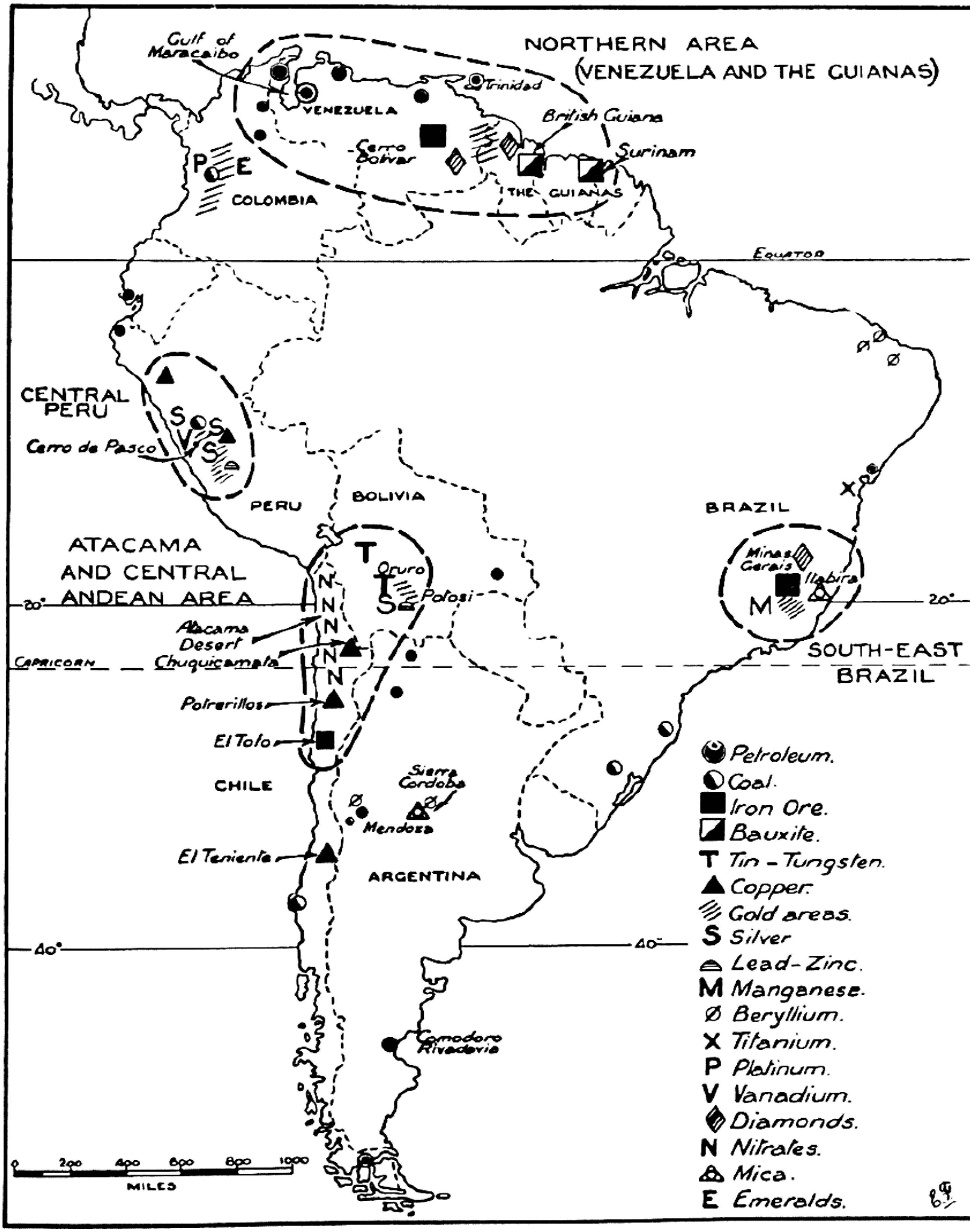


FIG. 42. *Main mining areas and mineral regions of South America.*

North American interests have become increasingly large and more active in iron ore, petroleum and bauxite in Venezuela and the Guianas. This, of course, is linked with the recognition of decreasing sources in their own continent and the lack of certain minerals which play a vital part in modern industry, e.g., vanadium. But in general, such activities develop from the fact that beyond occasional government assistance in building railways, as in Peru, there is not in the countries concerned either the money or the skilled technical staff. Frequently, very valuable ores in workable amounts are found to be in difficult environments; so considerable money is needed to bring to these deposits, by specially constructed transport, the required mining and processing equipment and trained scientific, technical and administrative staff. These usually have to be housed in special settlements and maintained with imported foods and clothing. Labour may be recruited locally, but sometimes labourers have to be imported and adequately cared for. Finally, the raw or processed products must be exported. Of course, conditions will vary from place to place, e.g., the Bolivian mines have difficulty with fuel for smelting, but hydro-electricity is available in south-eastern Brazil. Then again, the bauxite deposits of the Guianas are worked mainly by Negroes from the forest and coastlands, but the Atacama fields have to bring workers into such an arid environment. Further, water has to be brought long distances from the Andes to the Chilean copper mines and the oilfields of Peru, whereas around Lake Maracaibo there is an extremely humid climate. It is an area close to the sea, with a new deep channel being dredged, whilst expensive railways have to be built in most of the Andean lands to the south.

### Future of Mining in South America

With regard to the future of minerals in South America, we may note that some have been worked over so well that their end can be foreseen, e.g., some silver deposits in the Andes, gold in Brazil, and nitrates in Chile. On the other hand, some deposits would appear to be enormous and well-nigh inexhaustible, e.g., copper in Chile and Peru, iron ore and manganese in Brazil, tin in Bolivia, and bauxite and iron ore in the Guianas and Venezuela. Salt is available in large quantities in arid regions, and bismuth, sulphur and borax occur throughout the Central Andes. Petroleum is developing on a large scale, but the exact fields and reserve amounts are not yet known. Actually, South America has not been fully explored for its mineral deposits, and those which have been worked first have been those most economically available. The greater part of the present known wealth of the continent has been located so far in the high, barren and inhospitable Andes or in the interior on the Brazilian Plateau, where long distances and high freights raise the cost of production.

Competition from other countries and the quality of the minerals can be additional factors against the immediate opening up of certain reserves known to exist. As against that there are the growing demands for all minerals with new uses, e.g., copper, and an increasing interest in hitherto somewhat neglected ores, e.g., bauxite, asbestos, antimony, uranium and vanadium. Most of these are assuming new significance because of constant research, new processing methods and the world's growing need for minerals that were once mere chemical curiosities.

The association of manufacturing with minerals will be dealt with in the regional accounts.

## EXERCISES

1. Draw a map of South America to show the political divisions. Mark in and name the capital city in each State as well as any large towns. Write notes on the position of these capitals and towns in relation to the physical features.

2. Describe briefly the importance of minerals in leading to the economic development of the various parts of South America where they occur.

3. Compare and contrast the Andean Cordillera with the Eastern Highlands of Australia.

4. With the aid of Chapter XIV and books from your library, write an account of the means of communication throughout the Andean Highlands.

5. To what extent has the discovery of minerals in the inter-tropical lands of Africa and South America led to the opening up of these regions.

6. With the aid of a library book such as Gourou: *The Tropical World*, discuss the manner in which the physical environment of the tropical lands makes them difficult areas to settle in. Include insects and germs in the physical world.

7. Discuss the distribution and the exploitation of the main types of forest in South America.

8. Compare and contrast the physical environment (landforms, climate, soils and vegetation) of the Llanos of the Orinoco with the Pampas of Argentina.

9. Draw a map of the ocean current circulation round the continents of Africa and South America. Estimate the significance of these currents in affecting the climates of the two continents.

10. Write an account of the Andean mountain system under the following headings:—
    (a) relief and drainage;
    (b) natural vegetation of the eastern and western slopes.

11. On a map of South America mark in with different coloured pencils the prevailing winds for January and July. Relate these winds to the seasonal rainfall map on page 88 of this book.

12. Compare and contrast the deserts of South America and Africa *or* Australia.

# CHAPTER XI

# LAND USE

## General Observations

Some general observations on Figure 43 will be made here, since much of the detail relating to land utilisation will be given in later regional studies. When these have been read, this map will become more meaningful. For the present the following points may be made:

1. A big proportion of the country is either uninhabited or settled by peoples living under primitive conditions and following very simple occupations. In such lands there may be isolated settlements based on plantation farming, as in parts of the north-eastern slopes of the Andes or the coastal plains of Venezuela.

2. Considerable areas show an extensive type of occupational activity of the inhabitants, e.g., the commercial grazing lands of Brazil and Argentina.

3. The most intensive forms of economic development tend to be largely peripheral to the continent or associated with rivers, e.g., the tropical agriculture of south-east Brazil, the farming of central Chile in the valley of the Aconcagua River, the irrigation lands of Peru or the oil wells of Venezuela. These represent regions where environmental circumstances have favoured exploitation.

4. Certain isolated areas, such as the coffee lands of Colombia, the irrigation settlements of Patagonia, or the mineral areas of the Peruvian and Bolivian Andes, have types of products which warrant considerable expenditure of time, labour and money to obtain them and so the areas have spots of high population density in an otherwise rather sparsely settled region.

5. Some isolated dense settlements occur on coastal areas where good natural harbours do not exist but where the port is an outlet for an accessible hinterland of considerable richness. Examples are Buenos Aires, Valparaiso, Mollendo and Callao.

6. As the key to the map indicates, almost all the production of South America is purely of a primary type, showing that the general economic level of development is based on extractive activities like arable and pastoral farming and mining.

7. Many of the foodstuffs and raw materials that are produced from these activities find their way into world trade after local needs have been met. The income obtained from the sale of these products is used to pay

for imported manufactured goods in countries where manufactures are mostly confined to the simple processing of the products of the land before they are sent overseas.

8. Secondary and tertiary industries have shown signs of marked development in recent years. Their growth is almost invariably associated with urban development, which provides the much-needed labour pool. These centres are mostly on the coast, but sometimes special circumstances

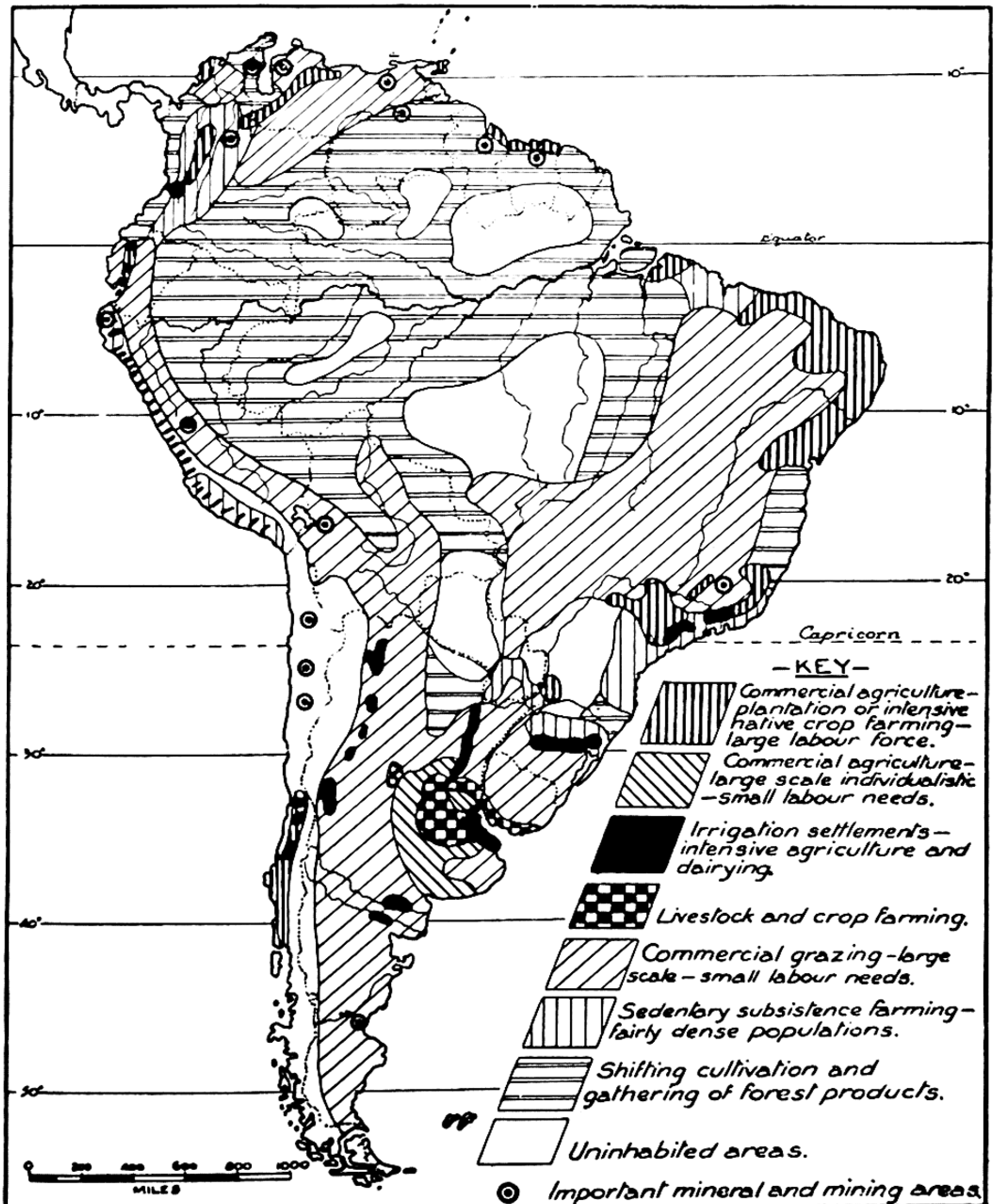


FIG. 43. *Generalised pattern of land use in South America.*

have promoted manufacturing development inland, as at Belo Horizonte, Sao Paulo, Rosario, Cordoba, Bogota and Medellin.

9. The commercial and agricultural land use is often linked closely with the colonial systems of land tenure as handed down from the Spaniards and Portuguese. This has had, and is still having, significant reactions socially, economically and politically, as will be noted in discussion on Chile and Argentina.

10. Land use and labour supply are often closely bound to the racial composition of the population in any one region. Thus we find a predominance of Negroes on the difficult coastal lands of Colombia; large numbers of Asiatics on the sugar-cane plantations of the Guianas; native Indians in the subsistence farming lands of the highlands; and large numbers of central and southern Europeans on the intensely farmed portions of Brazil and Argentina.

## Analysis of the Map (Figure 43)

**1. Arable agriculture.** Only a fraction of the country is given over to actual cropland, the two most obvious Republics concerned being Argentina and Brazil, with minor acreages in Uruguay, Chile, Peru, Colombia and Venezuela.

Apart from smaller specialised cultivation for crops like flax, sunflower seed, grapes and the products of irrigated areas like sugar-cane, cotton and rice, the most important crops are coffee, bananas, cacao, maize, wheat and alfalfa. The coffee, bananas and wheat are the basic exports, although there are fluctuations from time to time; and the alfalfa is the foundation of the fat livestock industry. The major production areas and trade in all of these is associated with either Brazil or Argentina, with Colombia and Peru as important secondary areas. Elsewhere cultivation is concerned mainly with purely subsistence occupations over wide areas of the continent. One reason for this is the greater difficulty inherent in the development of tropical lands when compared with those in temperate regions.

**2. Pastoral agriculture.** Although considerable areas are shown as being occupied by commercial grazing, it must be remembered that generally in tropical lands there is modification of the tropical climates by altitude, as in the Brazilian uplands. Even so, there is great difficulty with control of breeding, checking disease and the development of suitable transport routes from the interior to the settled lands on the coast. By way of contrast the Argentinian lands provide such an excellent environment for cattle that the export of meat and its by-products is a major part of that country's trade. The mild temperature conditions here in the eastern districts have permitted the building up of fine dairy herds. These are also found in southern Brazil, having a close relationship with the large cities.

In the Andean States and the tropical savannas of Brazil and Venezuela the obstacles to cattle raising are severe, and only hides, tallow and a few

good quality cattle are sent out. This bears a close resemblance to the development of the cattle industry in northern Australia.

Sheep for both wool and mutton are localised in the temperate lands of Argentina or Uruguay and the highlands of southern Peru. Here climatic circumstances are favourable for sheep and the industry shows signs of continued development.

Sedentary subsistence agriculture is more common in South America than is often realised. Apart from native Indians in such places as the montana on the eastern slopes of the Andes and Negroes on the tropical coastlands of the north, it is associated with many Mestizo* peoples in all agricultural lands in eastern Brazil, coastal Peru and the Colombian highlands. Here there are large numbers of people who provide their own food on lands adjacent to the larger properties on which they are employed.

The shifting cultivation and the gathering of forest products is the result of the natives' unequal struggle for existence in the environment of the great forest lands. When land there has been cleared and cropped for a short period, it becomes necessary to make a new clearing because the soil in the old one is quickly exhausted of all its plant foods. Collection of forest products is done by natives keeping in contact with trading posts, which in their turn provide simple clothing needs, some hunting weapons, and tools for commodities like chicle, nuts and wild rubber.

Europeans and natives concerned in timber getting generally manage nowadays to set up sawmills in suitable locations to handle such timbers as Spanish cedar, walnut and mahogany. These people have little effect on the land use in the selvas. Yet it is not unlikely that in the future the great timber reserves here will be drawn on to an ever-increasing extent as the supplies in the more accessible parts of the world become scarcer. Favourable factors in these lands are river transport, the immense reserves and the rapid rate of regeneration of the trees.

Summing up the land use pattern of South America, we see that there is a wide range of agricultural activities; but their actual locations show that, while there is considerable amount of intensive development by European peoples in temperate regions, the inter-tropical lands are for the most part either unoccupied or at an elementary stage of agricultural development. Only in certain favoured upland regions or on the coastal lowlands on the margins of these areas do we find modern commercial farming appearing.

The development of tropical lands in terms of the methods employed and their relationships to the life and densities of populations living there are discussed in the next chapter.

* *Mestizo* is a Spanish word derived from the Latin *mixtus*, mixed; and in South America and the Philippines it refers to people of mixed European and any coloured race.

# CHAPTER XII

# TROPICAL LANDS THROUGHOUT THE WORLD

In our studies of agriculture we note many types of farming, with widely different methods of cultivation and organisation. This we can recognise as being due in a large measure to the factors of environment. Crops and livestock have their own special requirements which farmers have come to recognise and for which they adopt certain techniques. In modern agriculture great advances have been made by scientific knowledge and use of new tools, new chemicals, new methods and new plants, but these developments are by no means universal, especially among the more primitive types of farming communities. Here it is not only a matter of spreading new ideas by education—and that is an enormous job—but of finding a means of having them adopted. For apart from a suspicion of such things, the native farmer is almost always bound up in a difficult economic and social system. He is almost always very poor and is tied to a community pattern of living which represents a long and strenuous attempt to adjust mere existence to a certain type of environment. Millions of the world's peoples are so situated, more especially in the tropical lands. In order to understand this more fully, we propose before going on with South America to study something of their differing environments, agricultural practices and problems. Then we shall look at the place and significance of white peoples in the tropics, noting their adjustment to them and their own special difficulties.

## Features of the Environment

**1. The limits of the tropical lands.** For the purpose of our discussion, we take the term "tropical lands" to mean those regions which, in general, have a hot climate with a summer rainfall. This also includes those portions of the hot desert with a summer rainfall. As was mentioned in our climatic studies in the chapter on Africa, the rainfall is related to the movement of the convectional rain belt. Figure 44(a) shows first, that the boundaries of the zone as described extend beyond the actual tropics, and secondly, that the areas between the tropics—the inter-tropical zone—include four main climatic types and a fifth one which shows temperature modified by elevation. The features of these climates have been discussed previously, but in view of their great importance to the rest of this chapter, they might well be revised carefully at this stage. Such variations as are especially significant will be discussed at the appropriate places.

**2. Landforms.** While these areas show all the major landform types of mountains, plateaux, hills and lowlands, it is interesting to note that the uplands are probably the most widespread, but the lowlands are probably the most widely used. Reference to our previous studies of the continents of Africa and South America will show clearly the relative amounts of these major divisions of landforms. You are also advised at this stage to have a look at the material and maps in the chapter on Central America (Figures 99 to 101). Note, too, in your atlas, the relation of the Deccan of India to the adjoining valleys and coastlands, the structure of the peninsulas and islands which make up south-east Asia and New Guinea. The tropical part of Australia is of special interest, with its large plateau and small coastal plains.

**3. Rock types and soils.** As might be expected the rock structures of the inter-tropical lands also vary considerably. But there are certain general features of these which are of great significance in their relation to the developments of topography, soils and soil erosion, human habitability and land utilisation. Thus there are considerable areas of sandstone which, while often producing fairly level surfaces, give rise to sandy soils of poor fertility which are prone to erosion after cultivation; this is typical of parts of Indo-China. Limestone also appears over large areas to produce rugged surfaces and make the storage of water difficult; the Brazilian uplands suffer badly in this way. By way of contrast the volcanic rocks of Java break down into fine rich soils. This is also true of the regur soil region in the Deccan.

Contrary to general popular opinion, soils found under tropical conditions are for the most part poor in quality and easily worn out and eroded once their plant cover has been removed and they have been cropped. The main exceptions, of course, are the newer soils of river plains and deltas, where alluviums may be renewed from time to time as in the lower courses of large streams. The climatic circumstances are the main reasons for this poor soil quality. The organic matter, which can be quite extensive in the forests that cover much of the hot wet lands, is decomposed quickly by the many micro-organisms which thrive in the heat. Then the thin cover (or even absence) of humus means that less water is held, and by percolation extensive leaching takes place. With continued heavy rain, alternating with wind erosion in dry seasons, rapid erosion is common everywhere. Lateritic soils appear in many places and because of their structure and infertility, they are rightly regarded as the curse of tropical agriculture.

Needless to say, the above processes have been speeded up by the techniques of clearing and farming the land as practised by many of the native peoples. This is especially significant in the case of equatorial forest dwellers, since the plants there, while not having much humus, manage to maintain it but not to increase it. Once it is cleared and cropped there is quick impoverishment and bad erosion. Actually the equatorial

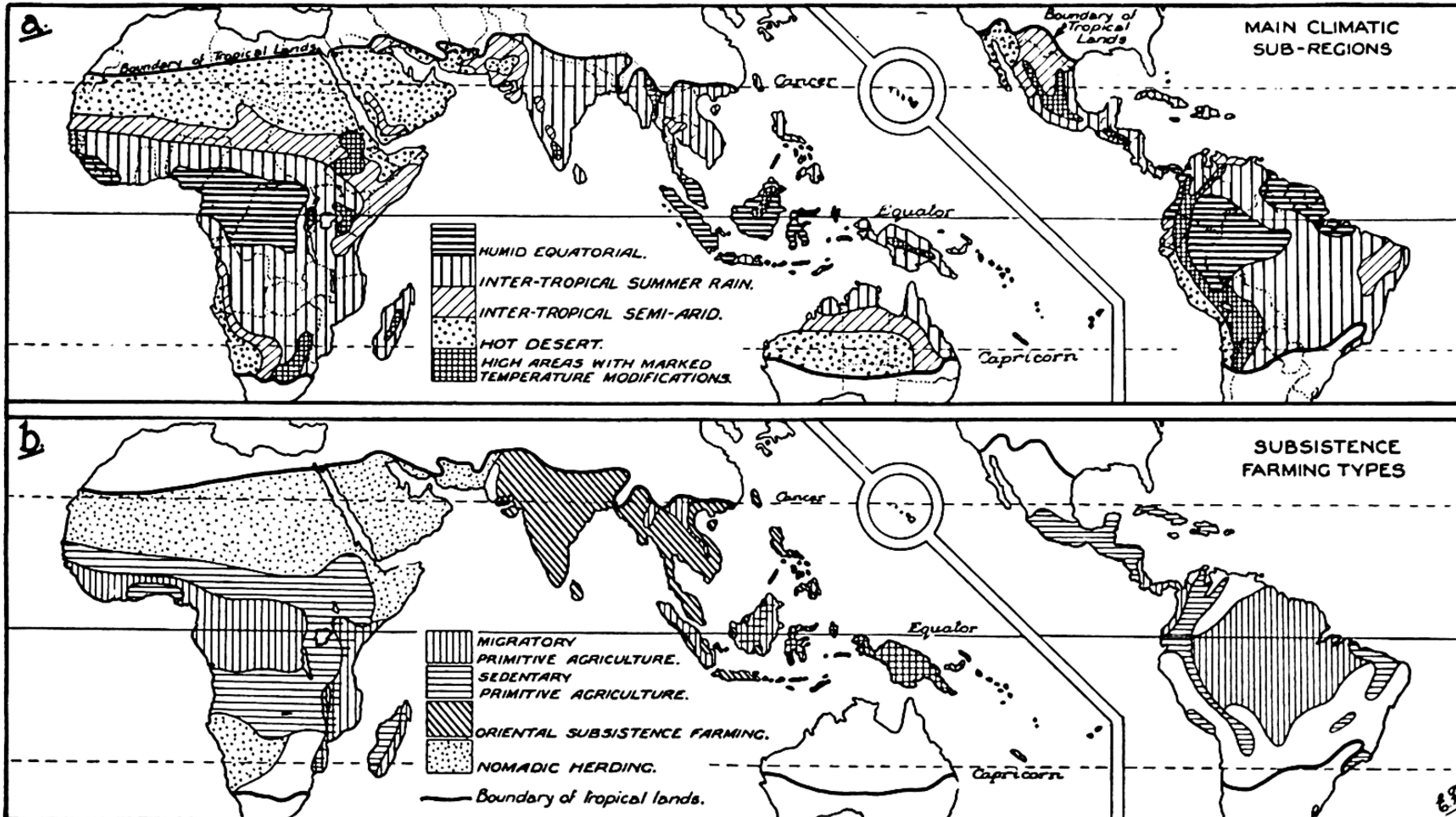


FIG. 44. *Tropical lands: (a) main climatic sub-regions; (b) distribution of subsistence farming types throughout the tropics.*

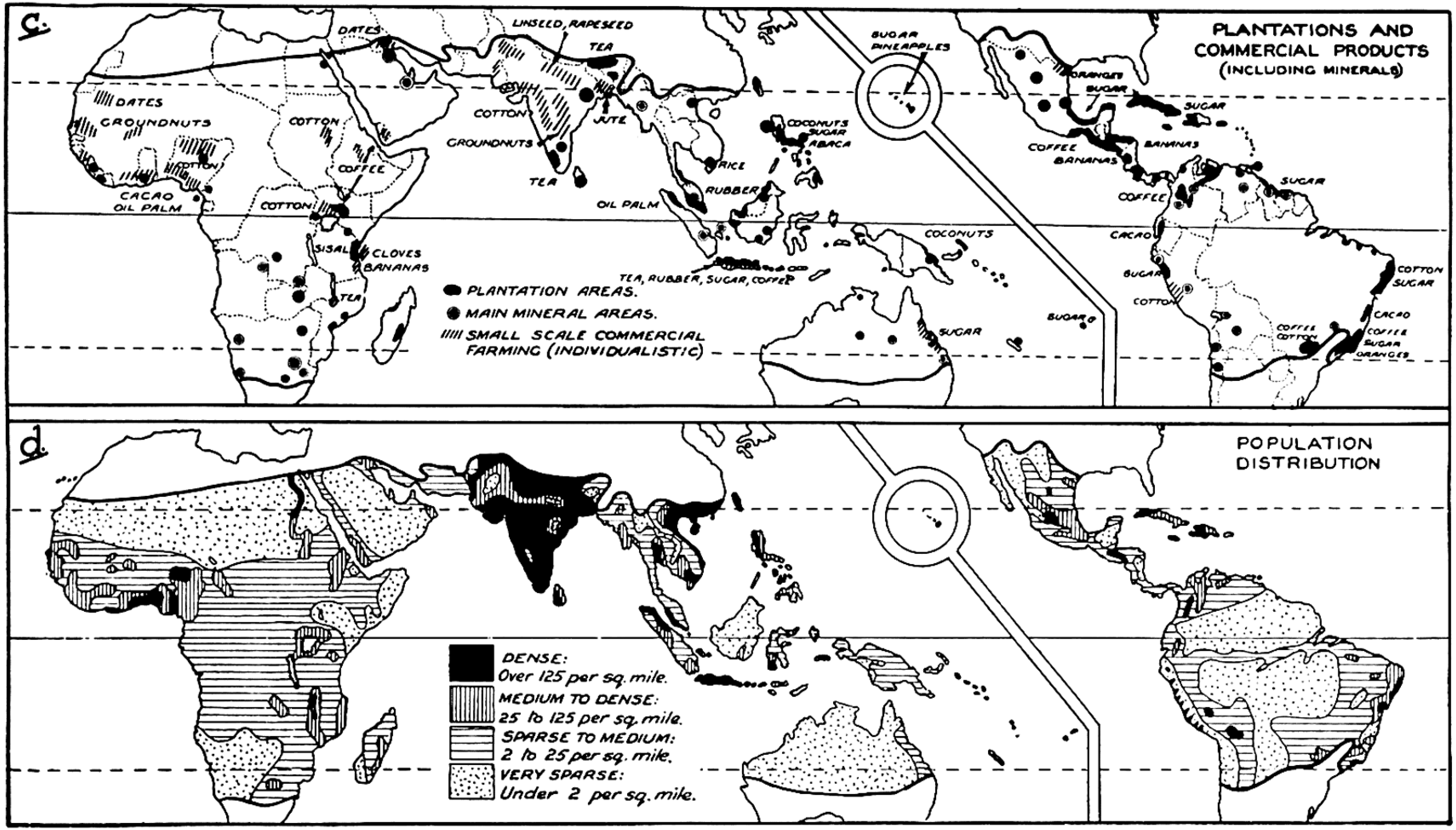


FIG. 45. *Tropical lands:* (*c*) *plantations and mineral products;* (*d*) *population distribution.*

forests are thinly populated because of their density and the difficulty in clearing them periodically with primitive tools. Most of the damage is done on the lands marginal to these, i.e., on those extending into the savannas. Exceptions may be quoted in the case of lowlands in south-east Asia, where the methods of farming and soil conservation obviate loss of soil fertility. Altogether, we can dismiss the idea that many of the tropical soils are very fertile, with great potentialities for agricultural development.

4. **Insects and diseases.** Added to the difficulties of the soils, most parts of the tropical lands are areas with many virulent diseases which make them possibly the most unhealthy regions of the world. These are due again to the climate, which, with its constant high temperatures and humidity, together with water brought by heavy rains, favours the development of microbes and the insects which carry them. The presence of these diseases in the hot wet lands is closely allied to agricultural life and the population, for they attack man and beast, either killing them or so sapping their strength that they cannot work effectively for the rest of their lives. Liability to infection is made easier if people are not fed properly or if prevention is difficult. As we have seen, poor soils will not produce good foodstuffs, while the native concepts of hygiene and elementary medicine are virtually nil. The most common disease is malaria, bred in heat and water and spread by certain types of mosquitoes. Sometimes it strikes in great epidemics, killing thousands and leaving many others fever-stricken for life to remain a constant source of infection to those around them. Further, they are so weakened that they fall easy victims to other maladies. *Malaria* occurs mostly in lowlands and on mountain slopes up to 2000 feet where conditions are favourable to mosquito life. Uplands with cooler temperatures escape to a degree. *Yellow fever* is another disease occurring in very hot climates such as those of the Amazon Basin and the west African coast. It was responsible for the deaths of many people in the Canal Zone, particularly during De Lesseps' attempt to dig the Panama Canal. Only very rigid precautions keep it at bay even now. Sleeping sickness carried by the *tsetse fly* is found widely on upland regions in the African tropics. It also occurs in Central and South America. Removal of forests can help to eradicate the fly, which breeds especially well amid heat and sheltering vegetation.

There is a wide range of other diseases which attack the limbs (e.g., yaws) and organs (e.g., cholera and typhus) of the body in a shocking manner. What is disturbing is the simplicity with which many of these diseases can be caught, e.g., by drinking unboiled water, eating unwashed vegetables or even walking barefooted on the ground. The location, variety and severity of all these tropical complaints will vary with a number of circumstances. In some cases they may be but a few, as in desert lands, where hot dry conditions fail to stimulate the breeding of either the microbes or their carriers. What does make for their wide

dispersion is the presence in endemic areas of large numbers of poorly nourished people (as well as animals) practising a primitive agriculture. As we shall see, the higher types of "vegetable civilisation", as in the monsoon lands, provide measures to control the diseases. To appreciate this better we shall now turn to an examination of the main types of farming.

### Economic Development

Reference to Figure 44(b) will show that within the zone of the inter-tropical lands there are four major land uses by native peoples. Whilst the main factors of environment just described do operate in varying degrees throughout the zone, each type of agriculture has its own special features and problems.

**1. Migratory primitive agriculture.** This will be seen to occur chiefly in the forest lands of South America and Africa as well as in some of the larger island groups, where it may be associated with sedentary forms, e.g., parts of Indonesia and New Guinea. Looking at Figure 45(d) you will notice too, that the population of such regions is sparse. The reasons for this are not far to seek.

The native peoples working in an enervating climate, often racked by diseases and not capable of long periods of hard labour, have evolved a type of agriculture which demands a minimum of work to produce foodstuffs. At the same time the method of farming shows a skilful adaptation to the physical conditions of poor soils, heavy and seasonal rainfall (sometimes irregular), heat and humidity. The method is simply to select and clear a small site by community effort, since it is usually part of communal land. Often the larger trees are left standing, for the small native axes and the scant energy of these people are incapable of heavy tasks. The felled timber and the undergrowth are then burned, the soil being temporarily enriched by potash from the ashes. They plant crops of either grain or root varieties with the first rains. This is done by most peoples with a digging stick (a dibber) or a hoe and sometimes by making ridges and heaps in which to plant seed. No fertiliser or manure is used, since animals are not kept for a number of reasons. People generally live in small clusters of huts, making a village in which the buildings never occupy land which could be used for crops. Some rotation may be practised so as to help prolong the yields. When exhausted, the plots are abandoned to the natural vegetation, and new sites are selected for further clearing, burning and planting. This means that the village will also be moved when the cropland is too far away. Foodstuffs may be supplemented by small game and fish from the streams. Some peoples also gather rubber and palm oil, which may be bartered for salt, tools and household articles in nearby trading centres.

The main results of this type of agriculture are that it does not give a high yield of foodstuffs and it badly affects the plant life by

burning off. In addition, soils are adversely affected by burning, over-cropping, leaching and erosion. Yet altogether it is possibly the only method of farming in the light of the physical conditions prevailing and the knowledge of farming techniques possessed by these people.

2. **Sedentary primitive agriculture.** The map will show that in certain regions of the East Indies, South and Central America and Central Africa, there is a farming practice known as sedentary primitive agriculture. Here the general farming techniques and the nature of the products have some similarity to those of the migratory farmer; but the farmer takes more care in the preparation of his land and in the cultivation and harvesting of his crops. He builds a better home and uses improved tools, which are often purchased from outside traders. In size some farms may be as small as two acres whilst others may be up to 30 acres. As far as working conditions and methods are concerned in these regions, the low rainfall and sparser vegetation cover make it easier to keep down natural vegetation growth. Soils also are less lateritic; they have a higher percentage of humus and are not as heavily leached as under equatorial rainfall conditions. Tillage methods are more intensive than with migratory farmers, but all work is still done by hand. Soils are seldom fertilised, and this, together with the crude methods of cultivation used, leads to low yields. Grain crops grown consist of rice (by irrigation), millet and sorghum, with manioc as a common root crop, and there is considerable variety and combination in any one farm. Animals are kept almost everywhere but are used rather as a source of labour than as a food supply. In highlands the hoe is used for tilling small plots on hillsides, which are terraced skilfully for irrigation purposes. Population spread is denser than in migratory farming regions, with some places having quite high densities.

Pastoral agriculture is not generally suited to the hot wet lands of the tropics. The physical environment is favourable only to arable agriculture, such as it is. Thus the grasses are not of good quality and the natives' habit of progressive burning to get better growth eventually destroys both plant cover and soil. Despite this, the animals have come to take an important place in the cultural and social life of the community. This is well illustrated in the case of the Masai people of East Africa, where a man's status in the community is judged by the number of cattle he possesses.

In spite of the adaptation of farming to environment and the ingenuity of their agricultural methods, the diet of these peoples is generally inadequate, and this is accentuated by the lack of stored food towards the end of the dry season, failure of rain and disease in crops. In addition, preparation of food is often crude and takes too long. All this has an adverse effect upon their ability to work and their susceptibility to disease. Raising the standard of living here is tied up with control of disease, better hygiene and general education in preventive measures. Better methods of farming might also be introduced to the sedentary agriculturalists, e.g., extension

of techniques like rice growing by irrigation as a substitution for destructive methods now used. This would provide crops of higher food value and assured supplies in dry years. Planting of trees, control of erosion, and better handling of stock might also be possible. Types of mixed farming could be introduced but would have to be thoroughly adapted to the environment and not merely imitated from those of temperate lands.

**3. Nomadic herding.** Pastoral nomads will be seen, by Figure 44(b), to be confined to hot, desert lands and those marginal to them in the inter-tropical semi-arid regions. From this we can see that while one group, like the Arabs, may keep to the desert proper, others will be attached to nearby grasslands. The general features of all are much the same in that basically they are concerned with following flocks and herds over areas where pasture is so limited by the climate as to permit only short stays in any one place. The limits of this grazing region have been established by usage over long periods and by agreement with neighbouring tribes. The family or tribe is the social unit, and the pastoral nomads are almost completely dependent on their animals for their livelihood. They use them as their main source of food, clothing, dwellings and utensils. Where possible, some supplement their food supplies by hunting the limited game there is in these arid lands or by barter of rugs and leather goods for grain, dates and fruit in nearby agricultural lands or oasis market centres.

These pastoral peoples do not have much contact except for barter of food and animals and live a simple existence. Figure 45(d) shows the population of the nomadic regions as being very sparse, since few people occupy these vast hot dry deserts of the northern hemisphere.

**4. Oriental subsistence tillage.** This is a type of agriculture found also in the hot wet lands of the inter-tropical zone where the cultivation of swamp rice and irrigation ensure a steady, abundant supply of cereals to a subsistence farming people who are at a high level of agricultural development. This cannot be explained purely in terms of the physical factors of the climatic regime, with its alternation of a period of intense rain with one of complete, or almost complete, drought. It springs rather from the mental approach of a dense population which has advanced to a high stage in civilisation. They have evolved a special method and structure in their agricultural industry which have enabled them to outstrip their less fortunate fellows of the migratory and other subsistence regions. All this adds up to a mastery of the soil, which permits a system of horticulture rather than farming.

The main characteristic features are small farms, usually broken up into non-contiguous plots scattered round a village where the farmers have their dwellings. On uneven land the plots are terraced up the lower hillsides. It is a garden type of agriculture in which individual farmers grow the crops by intensive hand-cultivation methods for direct human consumption. The hoe is everywhere outstanding among the few imple-

ments used by Asiatic farmers. Only about a third of the farmers use draught animals and ploughs, and the high yields are the result of painstaking human labour rather than of machine cultivation. Each farmer cultivates his own plot, but the whole work force of the village combines for certain activities. Planting, harvesting, clearing irrigation channels and maintaining terrace walls are tasks for the group rather than for the individual. *Rice* is the dominant crop over most of the region and it is associated with various dry-season crops. In growing it, crop rotation, developed as the result of centuries of experience, is a regular practice, together with much interculture (i.e., the growing of two or more crops at the same time in alternate rows on the one plot of ground). Because of the absence of pasture lands, animals other than the omnivorous swine, fowl and goat are relatively unimportant in the farming economy, but fish, both from ponds and open waters, are a vital part of the food supply of these regions. The continuous cropping has been made possible by constant heavy manuring of the soil, in the enrichment of which all the refuse matter from the homes, animals droppings and nightsoil are used. Since the major effort is directed towards the production of foodstuffs for personal use, there is little surplus of these products for sale outside the area. Owing to the common practice of utilising embankments round rice-fields and small plots near the villages, as well as the hillsides which are too steep for rice cultivation, for growing commercial crops, there is quite often a regional surplus of these for sale on the world markets. Thus we find cotton, rubber, sugar, soya beans, tobacco, tea, silk, coconuts and kapok all being produced and sold in large regional quantities by native cultivators as well as by the plantations within the area. It is from the sale of such products, plus the payment for occasional labour on plantations or large estates that the native farmer obtains small sums of money with which he purchases such tools and meagre household necessaries as he may require. Variations in these features occur in different regions. For example, in drier places a greater dependence is placed on irrigation. Rice ceases to be the main crop and is replaced by other grains. Holdings are larger and the land is less intensively cultivated. Risks of frequent and serious famine occur, as, for example, in the drier parts of the Indian monsoon lands.

These areas have possibly the densest populations in the world, because, as we have seen, their farming is based on sound agricultural methods; irrigation farming preserves soil fertility and prevents erosion, and intense cultivation helps to keep down diseases and gives high yields, thus largely eliminating famine. Altogether, it is a higher level of farming than that found in many temperate lands.

The intensive form of land use results in very high population densities with a general pattern of villages grouped at close intervals. Control of disease and medical education have helped to intensify these densities. But the increases of people within the south-eastern Asian area have created problems. The main one is that of food supply. Little or no new

land is available for cultivation, so that the food needs of the increased numbers have been met by slightly increased yields. But generally there has been an injurious effect upon the diet of the people from a general lowering of the calorific intake.

**5. The white man in the tropics.** The first commercial interest of Europeans in tropical lands in modern times was prompted by a desire to find a new route for bringing the silks and spices of Asia to European markets. These goods formerly reached Europe by overland routes through the Levant, but inroads of Ottoman Turks had partly closed them and made them dangerous. In the fifteenth century these moves towards new lands were also expressions of the national unity of certain States, of personal drive by ambitious rulers and commercial interests, and, to some degree, of religious missions. At this particular period Spain and Portugal were favoured geographically, lying as they do at the extreme south-west of Europe and jutting out into the Atlantic. From these vantage points they could direct and control their well-trained navies in voyages of exploration of new lands to trade with or to conquer. Although they did succeed in finding many rich minerals and concentrated on mining them, it was their accounts of other resources that stimulated much of the later exploration and development by other nations. As they exploited the known luxuries, Europeans found many new ones which were both acceptable and valuable for trade, e.g., tea, coffee and sugar. As a result the seventeenth and eighteenth centuries saw the rise and exploitation of overseas colonies (in both tropical and temperate lands) by British, Dutch and French. The Industrial Revolution, with its great demand for raw materials, saw an increasing interest in the tropical lands and the evolution of special types of land utilisation to produce the required products, e.g., the plantation system, of which we shall say more later. The interest has been maintained in modern times, especially since a wider range of plant products from the tropics can now be utilised more fully. Newer forms of land occupancy and peopling by Europeans have come with the discovery and working of mineral resources like iron ore, copper and petroleum. The actual movement of white peoples into the tropical regions today depends on a number of geographical factors. First there is the matter of the real need for certain products from the tropics, since they cannot be got at home. In some cases the need no longer exists, since substitutes have been developed, e.g., atebrin can now replace quinine (made from the cinchona bark, a tropical plant). Secondly, there is the question of whether the commodities would be secured by trade or would necessitate actual settlement, e.g., copra from coconuts or cultivated rubber. If there is to be a settlement, there are problems of transport, special equipment, and specially trained personnel. The quality and quantity of these will depend, in a large measure, on what the tropical regions have to offer, whether the resources are accessible, and if the climatic conditions will permit white settlement. This applies particularly to the mining of petroleum or valuable ores in

hot wet lands. In any case, once the settlement was established, it tended to produce certain patterns of land use and social relations. Possibly the best example can be seen in the plantation system.

(*a*) *Modern plantation agriculture.* This is an actual competitor to the native farmer, since it aims at developing scientifically and by the most economical and efficient methods, certain agricultural resources of the inter-tropical areas. Further, the plantation is much larger than the peasant holding and its objective is the large-scale production of a single crop specially suited to plantation methods, e.g., sugar, tea, coffee, fibre plants or rubber. This plantation method was one of the solutions to the problem posed by the growing demand for tropical produce by the European industrial populations of the nineteenth and twentieth centuries. New processes were coming into being and certain foodstuffs began to enjoy a marked popularity. The selection, setting up and successful maintainance of such agriculture meant that certain geographic considerations had to be met, other than the purely physical ones of soil, climate, and drainage. The placing of the plantation site was almost always on land unattractive to native people for food crops. A danger here was that large areas of apparently uncultivated land might well be part of the migratory farmer's territory. In any case, the general intention was not to cut across native interests and cause antagonism for a number of reasons, not the least being that they might well provide the necessary pool of labour needed in starting a plantation and maintaining it.

On the physical side the selection of the site may be bound up with a number of factors. Thus there is the slope of the ground, its drainage and aspect. Some crops demand fairly level topography for their effective working and the prevention of erosion, e.g., sugar-cane plantations. Other crops do best on well-drained slopes at certain altitudes, e.g., coffee and tea. Cacao needs protection from winds and does best on lowlands; while bananas like a situation free from frost and getting a maximum of sunshine. Then again, there are certain locational factors demanded by transport facilities. With the handling of raw or partly processed produce in bulk, or even in getting the harvest to a mill or plant, transport costs must be kept to a minimum. This is why proximity of plantations to rivers or coasts with good ports is valuable. The planning and supervision of both transport and processing calls for skilled scientific, enginpering and administrative staffs. Much of the labour is manual and involves such tasks as weeding, cultivating, grafting and hand gathering, so that a large labour force is required. In the tropical lands this may not be easy to get, and the workers may have to be imported, as were the Kanakas in the early stages of the Australian sugar industry or the Negroes and Chinese in the Guianas. The earliest plantation owners, of course, resorted to slavery as in the Cotton Belt of the United States. The price of the labour and the provision of housing may be costly items today. Sometimes it may be necessary to train certain selected local personnel in the slightly more difficult manual skills, e.g., grafting and rubber tapping. This is one of the

problems which develops in the placing of small plantation workers on their own properties. Large companies still have to keep a supervisory eye on various phases of the work, especially control of pests and marketing.

Many examples could be found to illustrate the working out of these various needs for successful plantation farming, but in almost all instances the three main economic factors were suitable cheap land and labour and plenty of initial capital.

Although the plantation system is now frowned upon by some, it has several features which commend it. Apart from bringing capital into a country, it may introduce worthwhile and badly needed transport and communication facilities. There may be new crops and agricultural techniques, including the control of pests, made available. Tree plantations may be the answer to preventing erosion or restoring lands badly affected. Health of the inhabitants may be improved by medical and sanitation measures. Finally, it is possibly the only method of producing, maintaining and controlling large standard quantities of specially needed produce, e.g., sisal hemp, rubber, bananas or coffee.

Against those arguments it is held that its effect on the native population is to be deplored; the natives very often never have the chance to learn any techniques which might be used in their traditional way of growing food and they will remain unskilled agricultural workers with nothing to take back to their villages. There are also geographical and economic grounds for its abolition. It is described as a "robber economy", ruining the soil, and, when the plantation is finished, leaving desolated and exhausted lands. The profits go out of the country and the owners are absentees. The wages paid are comparatively low when compared with those of the managerial staff, so that there is little saving of money among the native community and possibly a growing envy of the standards of living which can be afforded by others.

One of the major problems which arises out of these arguments is what will replace a system which really produced the goods with economic and technological advantages. Actually there are no adequate substitutes, although various experiments have been attempted with varying success and, in one case, with disastrous failure—in the peanut scheme in Tanganyika. It is to be hoped that some workable scheme will be evolved, so that the economic development of tropical lands will not be held up. In the Pacific Islands there have been interesting and valuable investigations and trials made, and the future of the South Pacific Commission should be followed carefully.

(*b*) *Commercial grazing.* White people have been engaged in pastoral farming in tropical lands for many years, e.g., in South America and north Australia. In Venezuela the industry has gone on since Spanish colonial times. It aimed mostly at local supplies, for the quality of the beef has never been really good because of the haphazard control of herds, the trying climate, floods, pests and lack of good transport. From the point of view of settlement, the owners generally will not live on their

properties in these circumstances but stay in cities. In contrast, Brazil has built up a very good cattle industry on its savannas. Here the conditions of living in the better parts are modified by elevation, and there have been scientific attempts to raise the quality of cattle bred in the tropics, by pest control and the introduction of special types of bloodstock. Again there is the social factor, such as operates in Venezuela, with the absentee owner delegating to managers. Nevertheless, there is great pride in the ownership of land and stock, apart from any monetary value. Northern Australia will be dealt with at some length in Volume IV; but it is well worth noting here that many of the problems of the other savanna lands in the tropics also occur in this country. Much has been done to improve matters with company ownership as against individual property holders, since they generally have the much-needed capital. In doing this special cattle have been imported and attempts made in pest control. An air beef scheme and road trains are trying to cope with the problem of long transport. There are still the physical difficulties of the climate and droughts, and the socialogical problems of lack of amenities and loneliness for families.

(*c*) *Mining.* Mining has created another form of white occupancy in tropical lands, especially in recent years. As Figure 45(c) shows, the development now is widespread and covers a variety of minerals. Africa shows possibly the greatest exploitation and you might make reference to your previous studies on that topic. All of the operations represent a large investment by white peoples, one of the most significant being that associated with petroleum. Some countries have gained immense wealth from this and the result has been large government expenditure in public services and utilities, as in Venezuela. Mining has also given employment to many native peoples, but in almost all cases it is limited to labouring or simple clerical duties. Whilst it has meant much money in native communities, it can be questioned as to whether that is a good thing in the long run for people whose culture is so deeply rooted in the agricultural life. Almost always it promotes a drift to the cities, with tragic results only too well illustrated in South Africa.

## Effects of White Settlement in Inter-tropical Lands

**1. In relation to white peoples.** On the whole the tropical environment has proved difficult for Europeans, and there are few parts where they have been able to establish permanent homes. Most of their difficulties are associated with the problems of living in the climate, combatting the diseases, learning best how to handle the soils and the croplands, and finally how to supervise and live with native peoples.

White people's health can be seriously undermined in most low latitude regions where there are constant high temperatures and humidity and little seasonal change. For that reason the development and settlement of the Queensland coast of Australia is a striking exception. In

general, white people in the tropics tend to settle in the highlands, as in the plateau of East Africa, where lower temperatures, greater variation in the seasons and plently of sunlight and fresh air make for healthier living. For this reason the people are able to lead energetic lives, although they generally avoid heavy manual work, seeing that native labour is so plentiful.

Europeans are as susceptible to tropical diseases as the native population, but they are less likely to succumb to them because they maintain a better diet and are capable of finding the means to destroy disease-bearing pests like the mosquito and the tsetse fly.

In coping with agricultural problems in the tropics, white people must study and adjust themselves to local conditions, such as may arise with soils, for example, as the Dutch did in the Guianas. In the colonisation of tropical Brazil, European peasant stock brought such inexperienced farming techniques to the land that they were finally reduced to a type of migratory subsistence tillage like the natives and in the process ruined whatever types of plantation crops they tried to raise. Some were partly successful with poor cattle in the uplands, and others drifted to hunting and fishing. Only in recent years has there been any stability in these types on the sugar-cane farms along the coast and the better farmed south-east, which was peopled by later immigrants.

In the contacts with the native population, white people have to deal with two delicate situations. One is the recruitment of labour, the other is the contrast in living and social conditions. In the former case it is often difficult to gain labour, especially among migratory peoples. Thus in East Africa the herdsmen despise manual labour on farms, while other natives may become restless or dissatisfied during the work because they are separated from their tribal groups or wish to get better wages in the towns and cities. In the second instance there arise the dangers of colonists appearing as a favoured minority enjoying a life completely alien to that of the natives who may well envy it. From such a simple situation serious social and political unrest may arise.

**2. In relation to native peoples.** The impact of the white peoples on the inter-tropical lands has had both good and bad results, although the initial occupancy was based on a principle of exploitation.

Disastrous soil erosion and loss of crops have frequently followed the clearing of forests for plantations and their subsequent abandonment. This was especially tragic in the West Indies. In Africa, more especially in Rhodesia, the introduction of the plough to native farms caused havoc in the complete destruction of plant life, soils, and even many of the beasts of burden. This was due to the thorough disturbance of the soils.

White peoples helped to spread diseases among natives both from their own infection, e.g., influenza in Fiji, and through introduced labour acting as carriers, e.g., it is suggested that Negroes brought malaria and yellow fever to the Americas when they were taken there as slaves.

Tribal organisations and cultures were often broken down and under-

mined. Thus the recruitment of able-bodied men for work in mines or distant plantations for long periods has a serious effect on village life, including the very economics of its food prodution. This type of breakdown has occurred throughout most of the tropical lands at one time or another. It has exercised the minds of New Guinea administrators for some time.

On the other hand, Europeans brought science to the tropics in the conquest of diseases like malaria. They have also assisted native farmers in their technique of growing commercial crops for world markets, e.g., cacao in West Africa. Such methods have also been linked with the control of pests and erosion, and increased yields by research. Better conditions for labourers have been gained by the extension of local developments in the form of schools and hospitals near their places of work. The training of native peoples for scientific and research work as well as for administration is only one of the features of the necessary education being provided, even to the extent of overseas studies. In this way the Colombo Plan has made a tremendous contribution to the welfare of many of the inter-tropical lands. Possibly the greatest advance has been in the encouragement of small farm ownership. This has helped to give stability and security both to the individual and to the group, and has done much towards encouraging a sense of nationality and a demand for greater realisation of the aspirations of the native peoples of the inter-tropics.

## Some contrasts between Tropical and Temperate Lands

In summing up our studies of the inter-tropical lands we are struck by the contrasts in environment and ways of life, and in the varying character and density of population. It remains for us to emphasise briefly the contrasts in degree of commercialisation and standards of living in the tropical as against the temperate areas.

Thus, the discussion of and constant reference to Figure 44 showed that while comparatively small areas of the low latitude lands had reached anything like a high degree of technical and economic development with a corresponding promotion of good living standards for some of the peoples there, most of the regions were backward in many ways. We saw that within these the climate, vegetation and soil conditions, as well as general inaccessibility, produced diet deficiencies, malnutrition and low resistance to disease. The resultant so-called "laziness" of the native peoples has made it difficult for them to improve their own conditions or to buy goods of superior quality, when and where available, to supplement their normal meagre foodstuffs like maize and rice. While attempts have been made to raise their standards of living by education in hygiene and agricultural methods aimed at a better-balanced diet, the techniques used by Europeans in their well-meant efforts have often broken down. The reasons for this lie mainly in the lack of the great capital needed, the degree of civilisation and system of government

already existing amongst the native population, and the failure to understand the local way of thinking. The natives often have a simple but stable way of rural life, with little or no interest in the accumulation of wealth. Europeans may then make the mistake of regarding this as sheer poverty and so proceed to change it by imposing a pattern of living similar to their own standards. It is well-intentioned but needs very careful introduction, for otherwise there might well be a serious breakdown of traditional rural communities, as has occurred in all the three continents under review.

Standards of living for these native populations may also be bound up closely with the actual policies and forms of administration followed by the different European nationalities occupying territories in the inter-tropics. This is possibly more evident in those regions where there has been the greatest economic development. As we have seen, this has been made possible by certain favourable circumstances of environment and the use of western scientific methods of production, as well as the control of health, plant pests, etc., e.g., plantation and/or mining ventures in East and West Africa, eastern Brazil, Indonesia, Malaya and the Philippines. (The last three of these, together with India and south-east Asia, will be studied in detail in the next volume.) Advances have been great in some instances, leading to the building of trading centres and ports like Singapore, based on the exploitation of the largest tin and rubber lands of the world. The growing demand for these and other raw materials and foodstuffs by temperate lands has led to an increase of native wealth and standard of living amongst those suited to administrative work, scientific skills and efficient farm management of their own properties. Yet apart from these few exceptions, serious problems have arisen to affect very materially the way of life of the bulk of the population. These have come from varying types of land occupancy and administration by white peoples. Thus the British, Portuguese and American possessions in South and Central America and the West Indies were first exploited by using Negro slaves, who on gaining freedom, still found themselves tied to the large plantation system as poor labourers. To this day the standard of living in places like Jamaica and Puerto Rico is leading to considerable unrest, whilst thousands of people in north-east Brazil eke out a mere existence in a region notorious for its famine. In East Africa and the Rhodesias large-scale European farming has often resulted in many natives being contained within reserves. The better educated and more progressive may own properties, but there is still a considerable pool of labour which is used on farms permanently or periodically or its members drift to cities and mining centres. Some living conditions there are good, even to the extent of good housing schemes, whilst others are bad, resulting in the development of shanty towns outside main settlements. Educational policy has aimed at better agricultural practices and technical skills, while stability of communities and government has been achieved with varying degrees of success by systems of indirect

rule through local chiefs assisted by district officers, and direct rule where there are mixed populations difficult to handle. In the Belgian Congo lands the rich resources are used widely to raise the standard of living, and education of European origin is given afterwards, while maintaining certain local characteristics and customs. By way of contrast, the French in the inter-tropics have always sought to develop their own cultural outlook amongst the native ruling classes with relatively high standards of living. The bulk of the population does not feature in this, although there is no strong colour bar. The system of the Dutch in Indonesia before the rise of the Republic there is also worth studying.

In contrast with these aspects of commercialisation and standards of living in the inter-tropics, we have a very high degree of development in most of the temperate lands. Something of this has already been seen in our work on Africa, and it will become more evident in our further studies of South America and the chapters on North America. It is sufficient for us here to note that there are many geographic factors responsible for this, with possibly the most important being those of the favourable physical environment. The climates, soils and natural vegetations are almost all suited to the life and work of white peoples. As a result they have been able to work with great vigour in the exploitation of the natural resources present in temperate lands. In so doing they have evolved very skilled methods of producing crops for foodstuffs and raw materials, for mining minerals and for utilising sources of power. Such advanced and widespread activities have given rise to enormous manufacturing centres and extensive and complicated systems of communication. The overall result has been the appearance of many and large settlements some reaching the status of the huge modern metropolis. The accumulation of wealth along with these developments has been associated with advances in general educational and cultural standards, medical science and social legislation, based in most cases on democratic forms of government. Altogether, then, the standards of living are, for the most part, high and advancing. Examples of these features are to be seen in most of the large commercial farming, mining and manufacturing regions of South Africa, the Argentina, the United States, eastern Australia and parts of Eurasia, especially western Europe. At the same time it should be remembered that not all the temperate lands are so favoured in natural and cultural development. It is easy to appreciate that many mountain and plateau lands would favour only more primitive standards of living, as in the Andes of South America, where there is also subsistence agriculture even about large commercial holdings. More precise examples will be seen in the detailed regional studies of various temperate regions. Use of the material seen there can make for very effective comparisons and contrasts between the environments, commercial development, standards of living and populations of the tropical and temperate lands. Problems of special interest will be those, which as we have seen already, arise from impacts between the peoples of these areas as they occur today.

# CHAPTER XIII

# DISTRIBUTION OF POPULATION IN SOUTH AMERICA

## Peopling of South America

**1. The Indians.** In order to appreciate fully the population character and spread in South America, we must first glance at something of its very early settlement. The original inhabitants of the continent were Indians, whose ancestors had come to the Americas from Asia via Bering Strait. Moving slowly down the western side of North America, they eventually entered South America by the land bridge of Central America (see Figure 46). They seem to have kept to the highlands, which of course gave them an easier penetration than by the jungles of the humid regions. From Bolivia there was a fanning-out to the plains of modern Argentina and the plateau of Brazil. During these migrations they gradually built up a variety of cultures which were in evidence when Europeans made their first contact with them. Thus in the far south were the primitive fishing peoples of Tierra del Fuego, to the north were the hunting tribes of Patagonia and the warlike and progressive Araucanians of Chile. In the savannas and tropical forests were both primitive farmers and hunters, while the Andean highlands were under the well-organised government of the Incas, who controlled many lesser groups. Such a distribution of the Indians came to be of special importance to the later conquest of the country by the Spaniards and Portuguese.

When these people came to this new world after the discoveries by the early navigators, they had accepted a treaty whereby, for purposes of exploitation, there was a rough division of the continent into two spheres of influence: eastern South America to go to Portugal, and the western portion to Spain. The boundary was approximately 50°W. longitude.

**2. The Spaniards.** After landing on the Caribbean shores the Spaniards, in small parties searching ruthlessly for precious metals, quickly over-ran the western uplands and coasts and spread inland from the Plata estuary. Reducing the Indians to the status of slaves to work the mines and do all transport and labour, they gradually established a series of important centres from which they exercised control and extended their searches. Such centres were able to do this by being almost always placed in a strategic position in or on the transport line to a mineral region or amongst the denser population of Indians. In the north, Bogota dominated the Andean highlands, from which riches flowed down to the port of Cartagena, whilst in the south Lima was the administrative centre with Callao

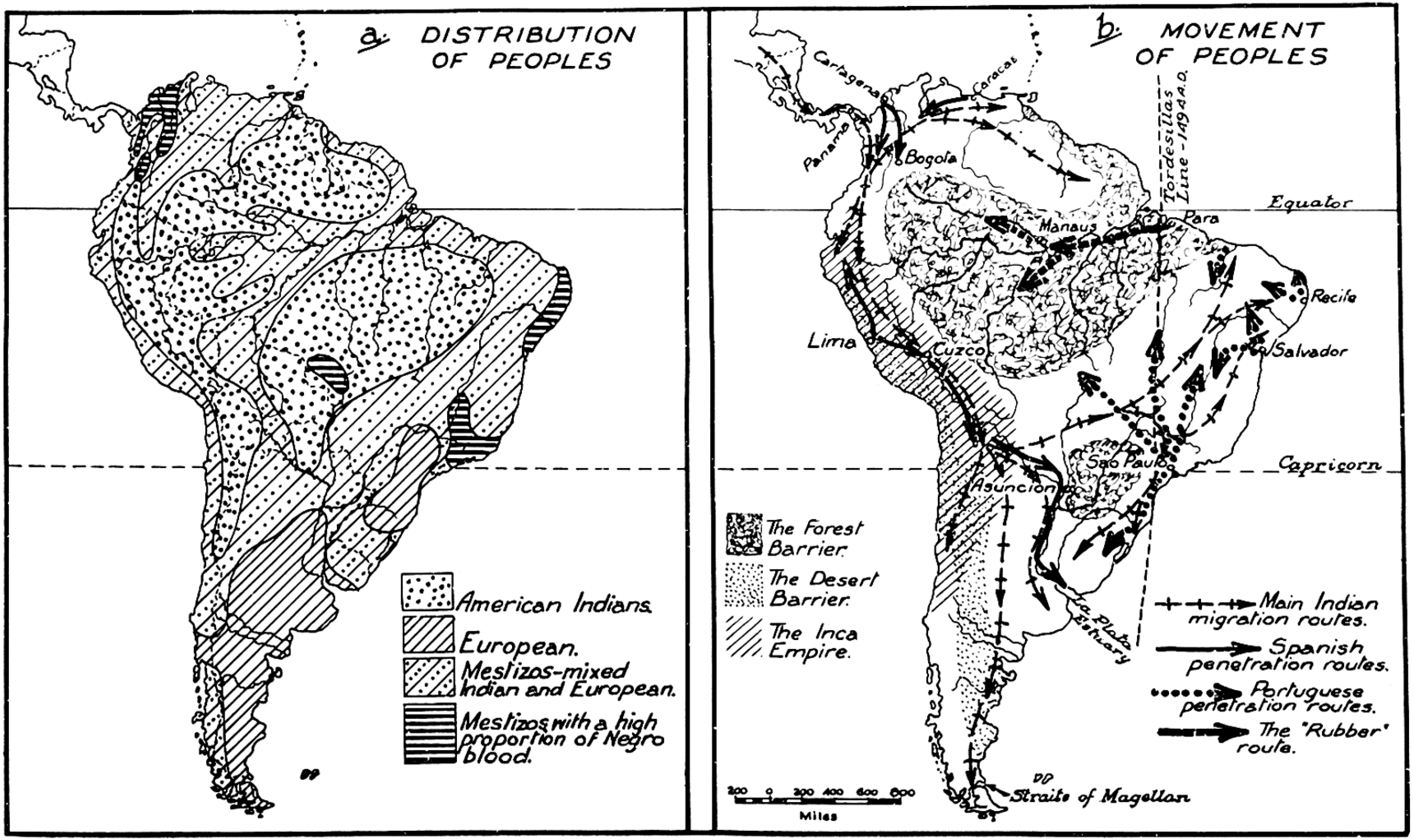


FIG. 46. *Major racial types and some important lines of movement of peoples into South America.*

the outlet. Such larger settlements all took on the typical pattern of Spanish town building of the day and can be seen now in many beautiful cities. The Spaniards never really came to colonise the country but to exploit it where they could, and for that reason there developed only a thin veneer of civilisation in certain areas, so that enormous tracts of more difficult country like the llanos, the selvas, the deserts and the cold south were never touched. But in the areas occupied there was widespread intermarriage with Indians, resulting in a large mixed race the Mestizos, and a caste social structure based on wealth and colour. These features have persisted to our times and help explain part of the racial mixture and the attitude of the wealthy aristocracy towards ownership of land and the use of tenants, for what they can give in social status and prestige. We shall see this frequently in our studies of the agricultural regions of the country.

3. **The Portuguese** made their first contacts in Brazil and were disappointed at not finding the expected sources of mineral wealth. Moreover, there was only a small Indian population with which to recruit a labour force. As a result there was little attempt to settle, since Portugal at the time held valuable possessions in the East Indies and in India. But by degrees it was discovered that in the north-east, about Salvador and Recife, it was possible to raise valuable tropical crops for sale in Europe. There then began a period of agricultural exploitation, with African Negroes as slave labour. It was here that the first sugar-cane plantations were developed, to be followed by others devoted to tobacco and coffee. Here again we see the pattern of social and racial distinctions appearing, for the large estates became the proud possessions of a landed aristocracy and the mixture of Negro and white produced the Mulatto.

Despite the exploitation and ruthless administration of the Spanish and Portuguese, they did much to introduce a highly cultured way of life, to open up the country economically, to teach agriculture and the arts of building, and to establish systems of law and order. Many of those who did this were the missionaries, who were not only zealous in their calling, but aimed at genuine colonisation.

These points are made here because they help to explain many of the strands in the population of South America today, including on the one hand the Latin outlook and approach to problems of commerce and society and on the other the Indian wish to be left alone to pursue a simple life of subsistence.

4. **Later immigration movements.** The final settlements of people on the continent can be divided roughly into two groups. First there were the later European interests in the Guianas to the north, with the English, French and Dutch staking their claims to possible tropical plantation lands. To work these they brought in further Negroes (many of whom escaped to the jungle to become the "bush Negroes"), East Indians Chinese and Javanese. Secondly, there were the large numbers of central

and southern Europeans and some Japanese who came into the country in the late nineteenth and early twentieth centuries. They settled mainly in the eastern lands of Argentina, Paraguay, Uruguay and Brazil, with a few in Patagonia.

From the above it is now possible to understand a little of the extraordinary racial and cultural differences which exist in South America today. These will become more evident in our later studies, but for the moment we might make the following general points on the present population of South America.

In the first instance it is calculated that more than 50 per cent of the people are Indian, Negro or a mixture of these with certain general localisations, e.g., considerable Negro peoples are in the tropical lowlands of the north; those of Indian stock tend to cling mostly to all the Andean States, in the uplands especially. Both of these groups also tend to fall into the subsistence and labouring sections of the people.

In the second instance, the white peoples of European birth or descent make up about 35 per cent of the population. They tend to settle in the more temperate lands of the south-east and west in central Chile. On the whole these form the groups who are landholders, agriculturalists, and industrialists, and who are interested in the economic and governmental welfare of the various republics.

## Present Population Distribution

On the map of distribution certain geographical aspects are evident, of which the more important may be summed up as follows:

1. In general the continent is comparable to Africa in the manner in which the landforms, climate and vegetation have provided *serious barriers* to penetration and settlement, so that the pattern is one of clusters of people confined to favoured spots which are mainly on the margins of the continent. Again, there is the contrast between these clusters and the enormous areas of country virtually uninhabited. Finally, there is the surprising fact that there are considerable numbers of large cities, which, like the more densely occupied regions of the country, tend to be in temperate lands, with only a few north of the tropic.

2. In a particular examination, we may note that the *sparse areas* are mainly those where equatorial and adjacent severe tropical conditions preclude settlement to a marked degree, e.g., the selvas of the Amazon and the Chaco lands. As well as these, there are the hot desert lands of northern Chile and southern Peru with the nearby rugged Andes. There is an extension of the arid conditions into Patagonia, where the desert is a "cold" one in high latitudes.

3. The *sparse to medium* density extends over much of the uplands and plains of the east as well as the Andean highlands. These are regions where there are extensive pastoral activities and/or subsistence farming.

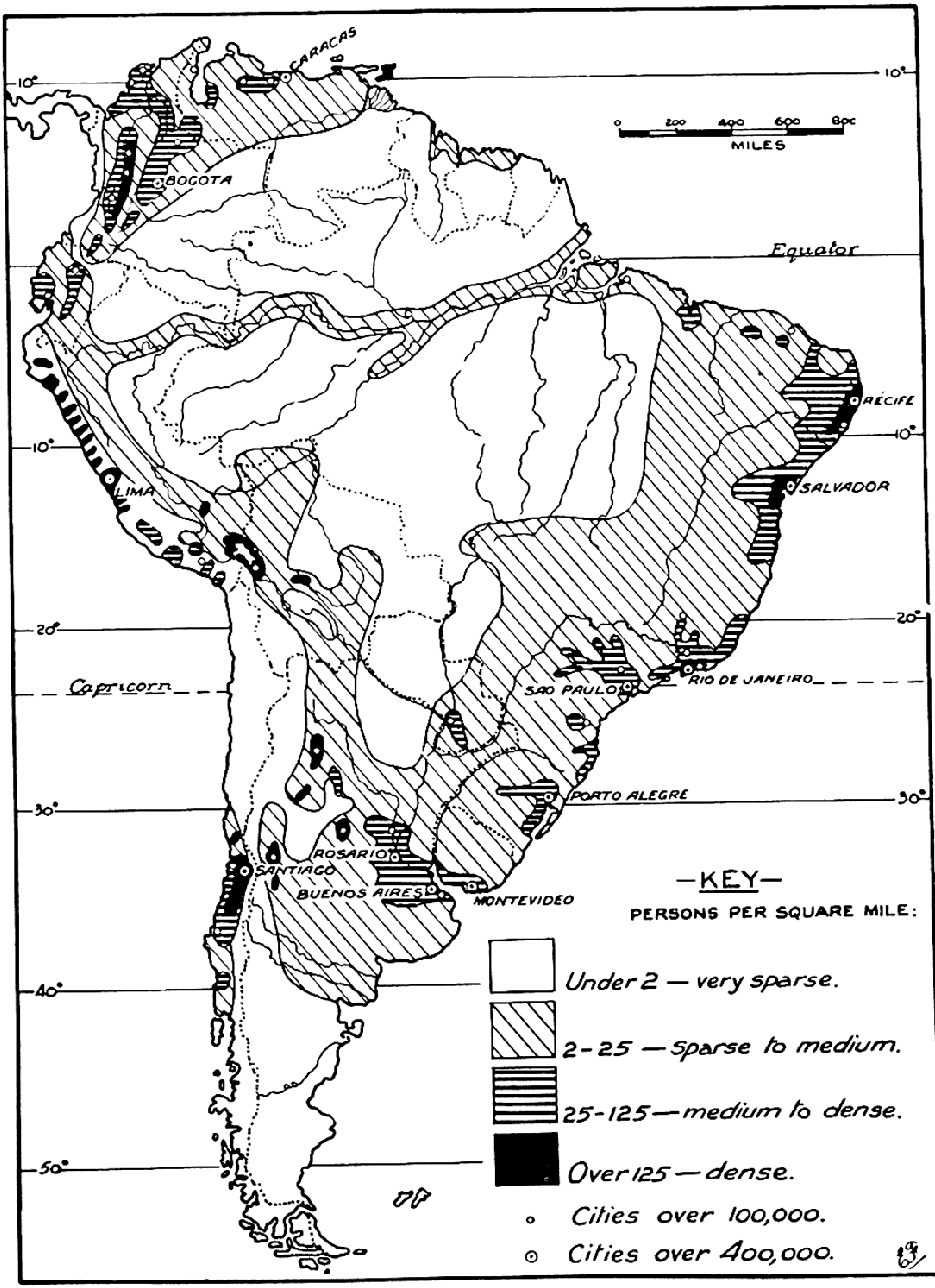


FIG. 47. *Pattern of population distribution in South America.*

There are also the navigable waterways of parts of the Amazon River, where some trading posts, with an occasional large city, exist to handle forest and plantation products. It should be noted that in these regions transport is an important factor, for it either does not exist or is very limited, as in the Andean lands.

4. The *medium to dense* lands are those with more intensive types of both arable and pastoral agriculture. They are limited in area and are localised; note their scattered nature in eastern Brazil, Argentina, Chile and Colombia. It will be noted that in most cases they are about cities which are the focal points of their occupational activities, e.g., Bogota and Recife. It is in these regions that transport would be much better if it formed a closer network, e.g., on the Pampas area of Argentina.

5. The *dense* populations, apart from cities as such, represent, in most cases, very intensive agricultural activity associated with irrigation or plantation methods, e.g., the river valleys of Peru and Chile, the oases of western Argentina and the coffee plantations of Brazil and Colombia. Mining in the Andes, together with localised agriculture in such regions, also accounts for several of these dense spots.

## EXERCISES

1. **Vocabulary words and phrases:** arable farming, chicle, Mestizos, inter-tropical lands, dibber, non-contiguous plots, plantation agriculture, Tordesillas Line (The Pope's Line), Mulatto.

2. Write a short note (about 1 page) on the significance of the hoe as an implement among subsistence and backward farming peoples.

3. Describe the essential features of the farm routine among the rice-growing peoples of south-east Asia.

4. Examine the main problems arising from the contact of European with native peoples throughout the inter-tropical lands. What positive moves have been made to solve some of these problems?

5. Why are very few large cities found in the inter-tropical lands? Account for the siting, development and present day functions of five large cities in the inter-tropical lands.

6. Give an account of the part played by the Incas, Spaniards, Portuguese, Italians, Germans and English in the development of South America. (You will have to consult encyclopaedias and texts on South American geography in the library in order to answer this question.)

7. Write notes on the production and importance of the following South American commodities: cacao, cotton, sugar cane, yerba maté, quebracho and wine. Indicate their distribution on a map.

8. Describe the general features of plantation agriculture and assess its value as a means of developing tropical lands and obtaining tropical products.

9. Draw a simplified map of the general pattern of population distribution in South America. Using this map, discuss the general relationship between population distribution and the geographic features of landforms, climate and vegetation in South America.

# CHAPTER XIV

# SOUTH AMERICAN TRANSPORT

In our later studies we shall see many examples which illustrate the fact that transport has been a vital factor in the opening up and development of South America. The great size of the continent, its large areas of rugged land, forests, swamps and deserts, together with its climatic difficulties, have always proved barriers to roads, railways and even human portage.

For these reasons, the rivers played an important part in the colonial history of the continent, and in many cases they are still valuable lines of transport and communication, although they vary from place to place according to their navigability and the types of regions which they serve. For example, the Amazon, with its 25,000 miles of useable waterways, enables penetration of the selvas, where roads and railways are absent (see Figure 48). But it carries much less tonnage than the Parana-Paraguay system; the latter, with difficult channels and competing against a network of other transport, has a relatively short mileage to sea from the heart of the country's richest agricultural region. In the north of the continent the Magdalena and Cauca rivers have been the main means of entry to the highlands of Colombia, in conjunction with short links of road, rail and mountain trail. The Orinoco permits only limited traffic because of its seasonal variability in volume. Entry to the Sao Francisco Valley from the sea is difficult because of the Brazilian scarp rapids in the lower part of its course.

The pattern of railways shown in Figure 48 is interesting because it is closely associated with the pattern of development. Thus we can see networks of railways in eastern Argentina and south-east Brazil, where there are the most agricultural, manufacturing and urban activities. Tentacle lines stretch out from these to interior lands with pastoral, irrigation or mining districts. There are also several trans-Andean links, some completed recently at great cost. Two transport systems of special interest are those of Chile, with over 600 miles of corridor and tentacle rail lines, and Venezuela, where wealth from petroleum has stimulated road-building in difficult country. The Pan-American highway is worth noting, although it contains many gaps. As we shall see, the Andean States have also made special features of their links between plateau and coastland.

Altogether there has been considerable progress in transport in South America in recent years, with new mining areas, greater intensification of agriculture and the availability of power either in hydro-electricity for the railways of Brazil or in petroleum for the Argentine lines.

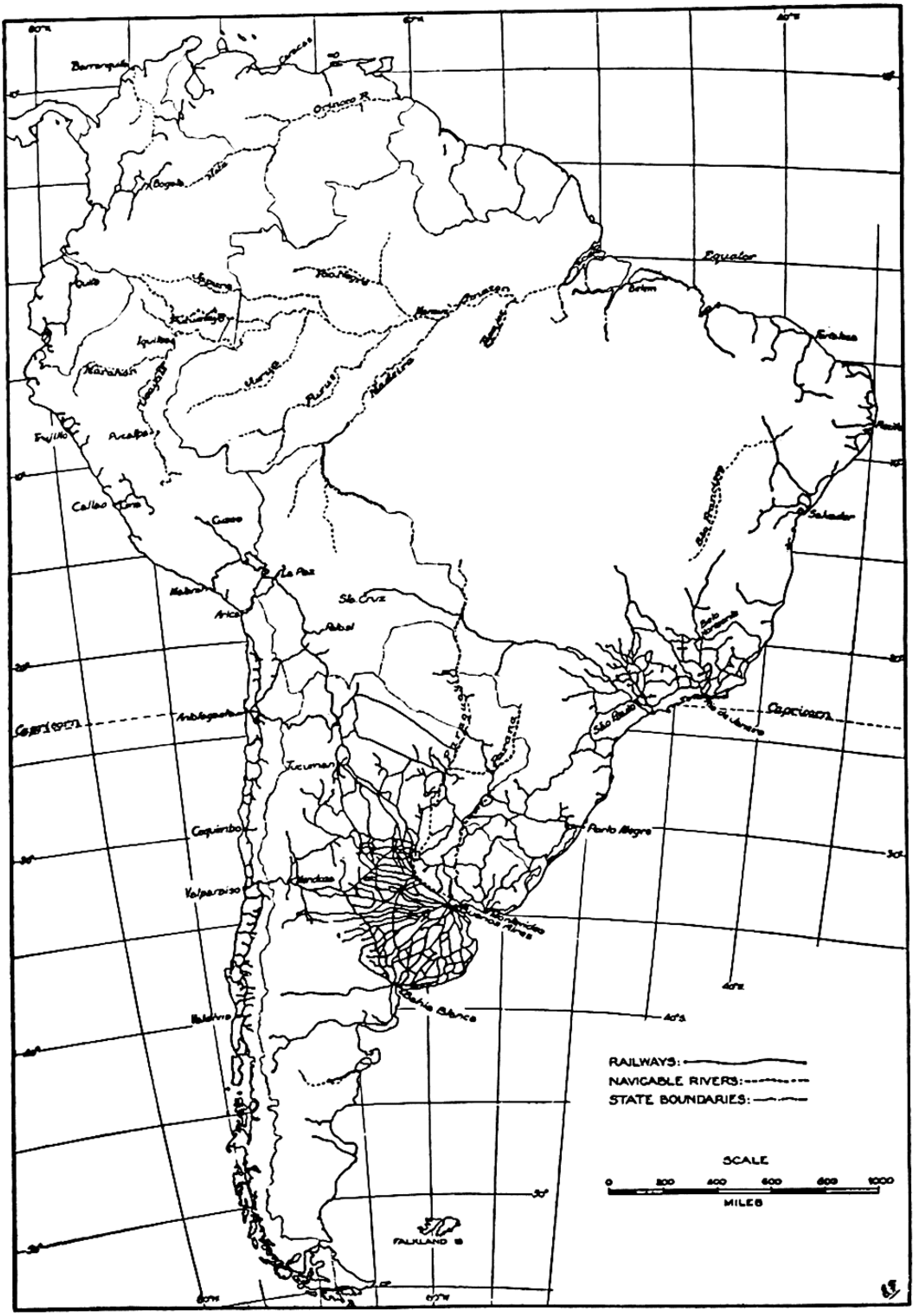


FIG. 48. *Pattern of land and water transport routes in South America.*

Airways cover most of the country, but are confined mainly to passenger traffic. They are valuable in a land of large distances and so much difficult landscape. They have a constant and close contact with North America and Europe.

Coastal shipping has played a considerable part in commerce in a country with so many difficulties in land transport, but here again there are problems of suitable ports for wealthy hinterlands. This is especially so on the western coast, where goods are frequently handled by lighters because of the rugged nature of the shoreline. Artificial ports are frequently built to cope with the situation, e.g., Mollendo and Callao. The eastern ports are more frequent and better endowed in their natural features, e.g., Rio de Janeiro. The northern regions have several ports which formed the entry for Spanish settlement in colonial times. Today several of them are being improved and new ones developed to meet the increasing mineral production, e.g., Lake Maracaibo Channel and Guaira.

At the same time there are large areas with literally no transport, or at the best the traditional mule on mountain and plateau trails, even where important export production exists, as in the coffee lands of Colombia. Such methods are wasteful of time, money and people. It may be many years before transport in South America will do other than serve the better-developed regions on the fringe of the continent.

## EXERCISES

*NOTE: These are general exercises on South America as well as on Transport; and many of them will necessitate a visit to the library for further research work.*

1. Show how the use of navigable waterways has affected the settlement pattern in both South America and Africa.

2. Discuss the relative merits and demerits of plantation agriculture and subsistence farming as methods of developing the rainy tropical lands.

3. Examine the importance of minerals in the opening up and exploitation of tropical lands.

4. Draw a map-summary to show why the Atacama Desert is rainless. Discuss the importance of this desert to Chile.

5. Show how geographical factors have contributed to the importance of the site of Rio de Janeiro, Mollendo, Quito, Bogota, Mendoza.

6. "Amazonia is a vast natural treasure house, which when tapped will become a place of fabulous richness." Evaluate this statement.

7. On a sketch map of each continent mark in carefully the lands in Africa and South America with a Mediterranean climate. Write notes comparing their respective landforms, climates, land utilisation and population distribution.

8. Compare and contrast the African and South American savanna lands, especially noting the human geography of each.

9. What are the main geographical factors favouring the development of air routes? Why has air transport become so important in Australia and South America?

10. Write an account of the development of one colonial possession in tropical lands so as to bring out the geographical problems involved in its progress.

11. Discuss the importance of scientists in the development of tropical lands.

12. Examine the possibilities of any South American Republic establishing large-scale manufacturing industries.

# CHAPTER XV

# NORTH ANDEAN REPUBLICS

These Republics have certain general likenesses in their regional divisions and development which are based mainly on the physical structure of the Andean system. Reference to Figures 35, 36, 37, 41, 49 and 55 will show these divisions:

1. **A region of coastal plains and ranges** with tropical and equatorial climates, excepting of course the Peruvian desert lands. Farming is mainly for subsistence, with commercial crops like sugar-cane and cotton and some petroleum deposits. Most of the main towns are markets or ports linked by transport to the interior plains and uplands.

2. **A series of intermontane basins** surrounded by high mountains. Here are variations in climate and vegetation with altitude, as stressed in Figure 41 particularly. There is a zoning of agricultural activities, both arable and pastoral, and much of it is for subsistence. Chief commercial developments are associated with large livestock properties, mineral mining on the plateau surfaces, and crops like coffee on the slopes. Most of the capital cities of the States are also on the uplands, where the bulk of the population lives.

3. **The interior slopes and plains,** where there are great forests giving way to savanna lands. Subsistence farming, with some commercial coffee growing, occurs in the former and cattle raising in the latter. Communications are by mountain trails and the headwaters of the upper Amazon. Altogether it is an undeveloped section, with a small sparse population.

The peoples of the Andean Republics in the rural areas are native Indians or Mestizos. They are occupied with subsistence farming, work as tenants on haciendas, or in the mines. Some Negroes are found on the coastal regions in the north. Generally all these people are very poor, but are contented to live as their forebears have done for the past 300 years. The inhabitants of the cities are largely of European descent with some Mestizos. There is a small class of wealthy landowners and mine-owners who frequently delegate control of their interests to managers and have little contact with the people or the country.

## Peru

This is the third largest of the South American Republics, having an area of some 500,000 square miles. It was on the uplands that the Incas developed their great empire long before the Spanish conquest by

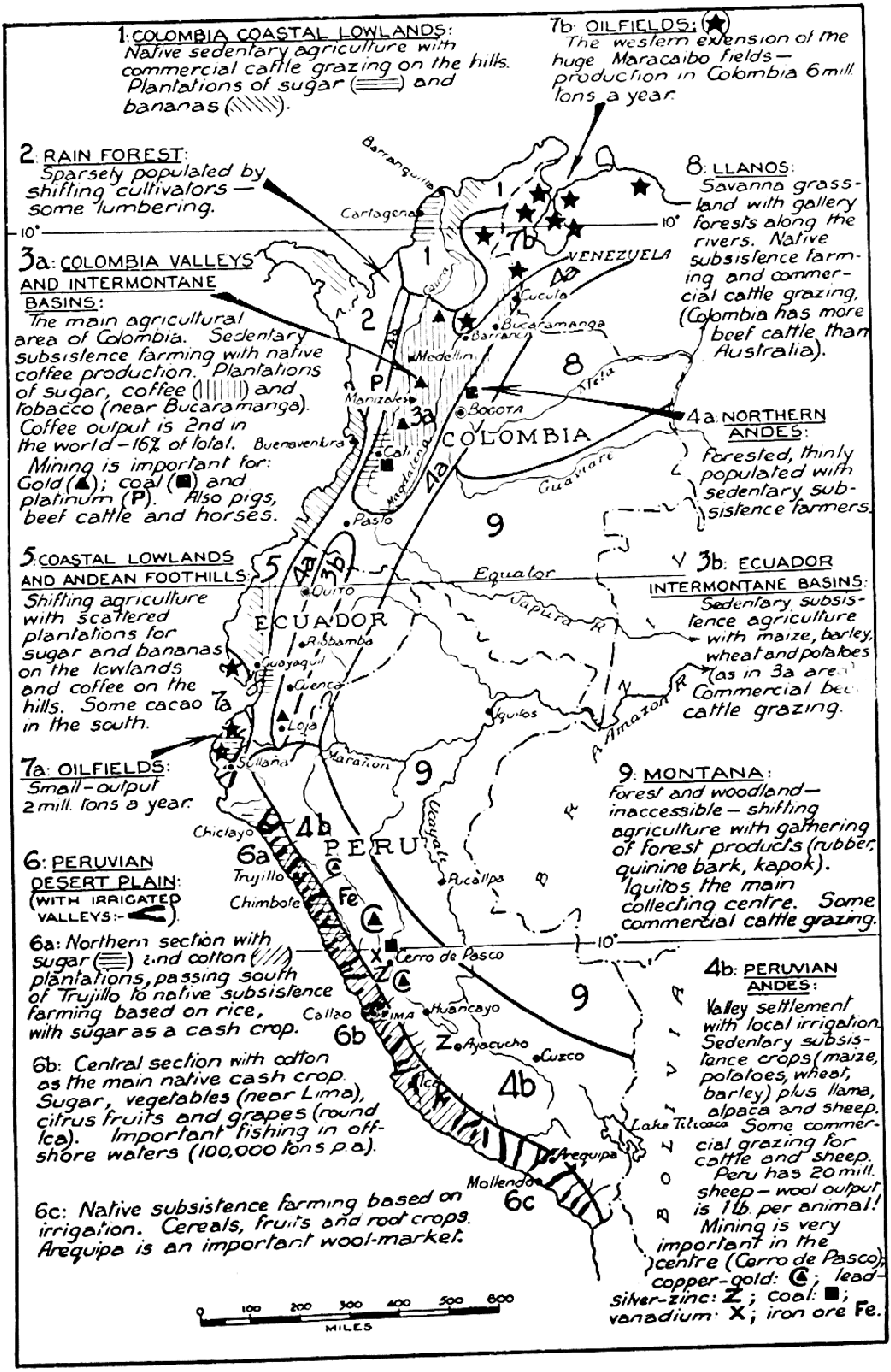


FIG. 49. *Map-summary of the regional geography of the North Andean States.*

Pizarro. Centred in their city of Cuzco, they developed an amazing system of roads, irrigation and flourishing settlements. Today the best lands are in the hands of the Spanish families and their influence is still important. It is a State rich in natural resources, but poorly developed. Much of its production goes to foreign investors.

It is divided into three regions as were the Andean Republics as a whole, with the eastern slopes and plains comprising at least half of the area.

**1. The Coastal Plain.**

(*a*) *General features.* This is about 1400 miles in length and for the most part lies between coastal ranges. Its width varies from nothing where the Andes rise sheer from the water to over 100 miles in certain areas, the average being between 30 and 40 miles. Although formed by an uplift of the continental shelf it is not level today, but is made up of a series of spurs and foothills from the Andean Ranges. Between these lie extensive alluvial valleys reaching well back into the mountains and watered by streams flowing towards the Pacific. Only about 10 per cent of the 50 main streams are permanent, the rest being torrents during the periods of summer rains and melting snows of the high Andes, and practically dry the rest of the year. These streams form a series of ribbon-oases in which irrigation is important, since rain seldom falls in these regions. Summer temperatures are not high, although the area is in tropical latitudes. These conditions are due to the cool Peruvian (or Humboldt) current offshore, which runs roughly parallel with the coast from the south to as far north as Ecuador. The south and south-east winds blowing across it pick up very little moisture, but on reaching the mountains, they form a zone of cloud and fog cover between 2500 feet and 4600 feet. This keeps down temperatures but produces no rain. Other results of these unique conditions are that the waters, under the cloudy conditions, produce much marine life for fish, which form the basis of an important fishing industry. The fish are also eaten by millions of sea-birds, which roost in great numbers on the many island groups off the coast. The fish waste and excrement they leave have dried out, under arid conditions, into a valuable fertiliser known as guano. Much of it was exported once, but the amounts are now restricted in order to use it extensively for the irrigated lands about the rivers.

This form of farming has been going on for hundreds of years, using very simple methods. In recent years the Government has started to build new irrigation works in the form of dams and channels in order to extend the area of cultivated lands. They have also provided instruction in improved methods of farming and have built up communications. As Figure 49 shows, the plain has roughly three divisions of irrigated oases. The northern section, particularly that lying between Chiclayo and Chimbote, is better than those to the south. Here there is a larger and more dependable water supply, more sunshine and fewer fogs. Types of irriga-

tion vary according to the nature of the streams, but they all aim at the production of commercial crops of cotton and sugar-cane and at subsistence farming of rice. The cash crops are grown on both small and large estates, with labour done by the Indians, some of whom have their own small farms for growing foodstuffs.

(*b*) *The northern section.* Most of the sugar-cane of Peru is grown around the city of Trujillo, with the aid of fertilisers mentioned before. Valuable crops of long-stapled Egyptian type cotton are grown mainly in the northern part of this section of the plain. Such crops, as in all tropical lands, have a special economic significance here because of their good returns in world markets. They are non-perishable and stand up to long storage and transport. Rice is cultivated mainly by subsistence farmers around Chiclayo, who use the water not needed for the irrigation of commercial crops. Together with beans, rice forms the main food of the peasant farmers and labourers, since it is easy to prepare, can be stored and helps to make nourishing meals. Most of that used locally is of poor quality, the better types being exported. Although the individual or company owners of the larger holdings do attempt improvements, the general social and living conditions of the small farmers and workers are not satisfactory.

Railways connect the main centres of farming, e.g., Trujillo and Chiclayo and the series of small ports like Chimborate. This port also exports coal to Argentine and may, with the use of hydro-electricity, develop a steel industry.

(*c*) *The central section.* In the central section of the plain, the oases and their cultivation are limited because there is less land available, the highlands are close to the sea, the supply of water is smaller, and there is less sunshine than in the north because of the fogs and heavier cloud cover. As a result we find a greater cultivation of cotton than sugar-cane, much of it being around and south of Lima, in which there are textile mills. A special Peruvian disease-resisting type of cotton with a long staple has been developed. It is of excellent quality and sells well on European markets, so that cotton is second in value in the exports of Peru. Quite a number of Japanese own farms in this region and employ Indian labour from the uplands in the picking season. This movement of people is also seen in the transhumance practised in summer months, when livestock may be moved up into the mountains because it is rainy there and good pastures develop between 2000 and 6000 feet. The return is made in the cool seasons, when grasses are then better on the plain. This custom is not observed in districts north or south of here. In the Rimac River valley, where Lima stands, there is extensive truck farming for city needs, while to the south a considerable number of vineyards are planted about Ica, which produces a famous type of brandy. Lima, the capital, stands some miles inland from its port, Callao, which has one of the best harbours on the Pacific Coast. It is the only capital of the Andean

States on a plain and not on the plateau. Founded by Pizarro in 1535 because of its strategic position, it still maintains its essentially Spanish character of fine buildings, streets and avenues. It is the commercial, cultural and educational centre of the country as well as being the seat of government. Its university is the oldest in South America. There is considerable industrial activity, the main manufactured goods being textiles, clothing, foodstuffs, leather and luxury articles; but as on the farmlands, the urban area shows marked contrasts between the poverty of the many and the wealth of a few.

(*d*) *The southern section.* The southern part of the plain extends roughly from Ica to the Chilean border. Irrigation and farming are much more restricted here by the rugged nature of the country and the increasing aridity. As the map indicates, the narrow irrigated areas along the streams are sometimes limited to the headwaters. Indian subsistence farmers exist here, with only a few oases of special commercial significance. One surrounds Arequipa at the foot of the famous El Misti volcano, and grows foodstuffs for that city. Another, farther south, is noted for its olives and grapes. Arequipa is important, not only as a market centre for the plain but as the gateway to and from the uplands of Bolivia and the eastern slopes of Peru and Brazil. Important wool exports come here from regions like Titicaca and Cuzco, which are linked to it by rail. Mollendo, in spite of the harbour difficulties due to its open character, has been the port for hundreds of years. It is now being abandoned and a new outlet, Matarani, is being built on modern lines some miles to the north.

The several oilfields in the far north of the region have been producing for many years under Peruvian and foreign control. Production is much less than in Colombia and Venezeula, but the local demand is small, since the average peasant cannot afford oil for heating and cooking. Neither is there much use for it in manufacturing, since there is hydroelectricity available.

**2. The Peruvian Andes.**

(*a*) *The land and the climate.* These occupy nearly two-fifths of the area of Peru and extend in a great band 200 to 250 miles wide from Ecuador to Bolivia. They consist of western foothills lifting above the coastal plain, forested in part, and rising to a series of almost unbroken ranges of from 18,000 to 20,000 feet. Beyond these are the mountain basins at average heights of up to 12,000 feet, and these are flanked on the east by more towering mountains. The surface of the plateau is broken into wide valleys with gently sloping sides or is cut by enormous canyons. The northern section is drained by the long Amazon headwaters, which come within 100 miles of the Pacific, while the south forms the inland drainage basin of Lake Titicaca on the Altiplano. One of the best-known of these high valleys lies between the lake and Cuzco, while another is in the north at Cerro de Pasco, Oroya and Huancayo.

The climatic conditions and vegetation vary considerably with altitude, latitude and aspect. Special features are the clear skies, the rarefied atmosphere, and the daily variations in temperature; there can be great heat during the day-time and freezing nights. Rainfall is fairly low, coming mainly in summer, with the rest of the year very dry. Plant life varies with height, but grasses and shrubs are most widespread and characteristic. The paramos (bunch grasses with taller plants and bush) appear in the north, and puna over most of the width of the Andes on the south (see Figure 41).

(*b*) *The people and their crops.* People unaccustomed to life at these altitudes suffer from mountain sickness, difficulty in breathing and loss of vigour; but the true natives of the plateau have become used to these conditions. Their forebears were the Incas, whose empire first arose in the upper Ucayali Basin, but who later spread over most of the plateau and adjacent regions. Their civilisation was based entirely upon large-scale agriculture, which, because of the scanty rainfall, was only possible with irrigation, using water from glaciers and snowfields. They built channels and terraced hills with great engineering skill so as to cultivate every available acre of ground. Because of their special significance in farming, the sun was worshipped, maize was regarded as an almost sacred crop, and the potato was grown over a wide area. The chief animals were the llama and alpaca, useful both for their wool and as beasts of burden. They developed a unique system of government and centred it on Cuzco. Although almost all of this was lost with the Spanish conquest, when the Indians were enslaved in the gold and silver mines, the inhabitants of the plateau are still almost wholly of Inca stock. Further, in spite of considerable developments in mining, their major activities are agriculture and the raising of livestock. Farming methods are still crude, e.g., using wooden ploughs, planting by broadcasting, hand cutting, threshing and winnowing of the grain. There is a very strong resistance to modern techniques of cultivation; the Indian shows little interest in, or desire for, change, being content with the type of life his people have followed for centuries.

Most of the foodstuffs grown are consumed locally, but there is some export of agricultural products via Lima. Some of these peasants or peons hold land in common; others work on the large haciendas, which raise stock for commercial purposes on high altitude grasses like the punas. Some of these properties may run to tens of thousands of acres, especially in the northern districts, and are owned by wealthy families living in the cities. Land and labour are cheap, little is done for improvement of stock, and the quality is generally low. The meat is sold locally and the hides are exported.

The southern uplands are too dry, bleak and windswept for cattle, so the raising of sheep for wool is the outstanding industry. Bred at heights of 10,000 to 13,000 feet, the improved types keep healthy and flourish here with the wool clean and free from burr. The clip goes to

Arequipa, where it is classed and baled. This is an industry with great possibilities. Wool also comes from the llama and the alpaca. It is shorn and sold by the Indian owners, but they use much for themselves. The women specialise in spinning and weaving this wool into "ponchos" (large sheets with a hole in the centre, which are very important articles of clothing in the highlands). Because of its warmth and protection the poncho is a combined blanket and overcoat. The finest and most valuable of the wools is that of the vicuna, but this animal is not domesticated and has to be hunted at high altitudes.

(*c*) *Mining.* Economically mining is a much more important industry than farming throughout the northern highlands. The deep mineral veins are exposed by folding and erosion in the Andean Ranges, and they are now exploited by large-scale mining, processing and transport methods brought by foreign companies. The oldest and most famous district is that of Cerro de Pasco. Here at 15,000 feet are mined copper, lead, zinc, mercury, bismuth, antimony, arsenic, silver and vanadium. The last two are specially important, Peru being one of the world's main sources of vanadium. It is a rare and valuable mineral used in the making of certain special steels of very tough quality. Some coal is obtained near by, and this helps in the working of a smelting plant at Oroya. Another important mining district is being opened up in the north round Quiruvilca. It is probable that many rich deposits of minerals are still to be located and worked in these regions, but the cost of transport by rail in such a region would most likely be against their being mined profitably. Railways are necessary for the development of mineral resources and the products of the mines. As it is, the chief railway from Oroya and Cerro de Pasco to Lima is an amazing piece of engineering skill and was very costly to build.

**3. The montana.** This region, occupying about half of Peru, is made up of a series of greatly dissected slopes and steep valleys on the eastern side of the cordillera, descending finally to the plain of the upper Amazon. The drier and colder conditions of the upper areas produce good pasture lands, and crops of potatoes and barley. At lower elevations, from 8000 feet downwards, the increasing rainfall and temperature produce forests called *yungas*, which merge into the selvas as shown on Figure 41. These lower slopes and valleys are very fertile, fairly healthy and capable of considerable agricultural development. The great problem is transport, since the geographical location of this region either in relation to the western coastland ports or down the Amazon to the east coast makes it one of the most inaccessible parts of the continent. Hence, apart from the few natives engaged in shifting agriculture and the gathering of forest products, such haciendas as do exist are largely self-sufficient. Land is cheap and native labour is recruited from the highlands. The only products grown for sale are those capable of standing the high costs of transport to the markets. These are coffee, sugar and coca, the last named being the plant from which the drug cocaine is made.

Apart from aircraft, many trucks and buses are now reaching parts of these inland areas by means of newly made trans-Andean roads. One is from Lima to Pucallpa on the Ucayali River via Oroya, Cerro de Pasco and Huancayo. The final leg of the trip of 650 miles to Iquitos is by river steamer and takes three days. Other routes include considerable stretches of mountain trails.

Iquitos is the growing commercial and transport centre of the montana and upper Amazon. It gathers a wide variety of products to send them 2300 miles down the river. This settlement got its big start as the chief rubber collecting port for Peru when its hinterland was the chief source of the world's rubber supply.

## Colombia

Colombia occupies the extreme north-west of South America and is the fourth largest State of the continent. It is also the only one which touches both the Pacific and Atlantic oceans and is closest to the Panama Canal. There are some 460 miles of coastline on the west and 650 miles facing the Caribbean. The Spaniards, who first penetrated here, called the country New Granada, a name which persisted until towards the end of the nineteenth century. Although their colonisation was marked by violent excesses, they did much to develop the land with their advanced civilisation and building of cities and roads. Enormous wealth was taken out of the country, and during the sixteenth and seventeenth centuries pirates attacked the laden galleons and the ports from which they sailed, so that the northern coast became part of the famous "Spanish Main". Today the Spanish influence is seen partly in the composition of the population of Indians, Negroes, Mestizos, and Europeans, and in their particular locations in various regions. Until recently the difficulties of access and transport, trade, labour supply, capital and internal government held the country back. These problems are being met in a variety of ways.

**1. Physical features.** The physical structure of the country determines in a large measure the natural and cultural features. Reference to Figures 35, 36 and 51 shows how this structure is based on the Andean system. Three high cordilleras, the Western (or Occidental), the Central, and the Eastern (Oriental), spread out like a great fan towards the Caribbean coast, where there are lowlands broken up by much lower extensions of the mountains. The result is a series of wide deep valleys reaching into the heart of the country where there are plateaux and mountain peaks, some of the latter rising to 18,000 feet. In this way there is a marked contrast with the totally enclosed basin of the other Andean States. The main rivers flowing in the longitudinal troughs are the Magdalena, its tributary the Cauca and the Atrato. The last named drains a 300-mile valley lying between the Western Cordillera and the coast range. Between this range and the coast is a narrow plain facing the Pacific. Unfortunately,

much of the navigable water of the rivers is interrupted by cataracts. To the east of the Oriental Cordillera are the inner Andean foothills and portion of the western plains of the llanos.

Such a diversity of landforms helps to produce a diversity of climates, the details of which we shall see in the various regional divisions.

**2. The Pacific coastal lowlands.** This region has one of the most difficult environments for human existence in the whole of the continent. In addition to the equatorial climatic conditions, much of the land is low and swampy with poor soils. It is covered with dense forests, especially in the north, and here the tropical diseases of malaria and hookworm are rife. As a result the population is sparse over most of the region and consists mainly of Negroes; they have displaced the Indians, who could not stand up to the conditions. Under such circumstances it has always been difficult to secure labour to work for forest industries, mining and plantations. Transport is always a problem. Forest resources are many, but the main ones exploited are hardwoods, balata, kapok, tagua (or ivory) nuts, and palm fibres for panama hat manufacturers. On the slightly less difficult situations of the slopes, sugar, coffee and cacao plantations have been cut out of the forest. But the Negro labourers are hard to secure, either because they prefer the haphazard existence of collecting in the forest or working small subsistence farms, or because there is strong competition from the companies seeking minerals. The main ores are gold and platinum, which are worked by dredges and small prospectors in the gravel beds along the Atrato and its tributaries. Colombia at one time was the world's chief producer of platinum, which is used extensively for jewellery and in the chemical industries. Most of it is exported to the United States via Buenaventura. This is the outlet for most products of the lowlands, but an increasing amount of products is now going through Cartagena to the north. Buenaventura has increased its transport and commercial status by reason of its links by road and rail with highland centres like Cali in the upper Atrato and Bogota, the capital of the State. Additional transport facilities, e.g., a railway to Cartagena, extended to the other areas of the adjacent plain and basin regions will give them further economic significance, especially as they are so close to the Panama Canal zone.

**3. The Caribbean coastal lowlands.** These consist of low plains built up mainly by alluvial deposits from the rivers Magdalena and Cauca. Large areas are swamps, while others are covered in flood seasons, but are dry enough for cattle pastures in the dry period. To the north of them is a small but very high (18,000 feet) offshoot of the Andes. On the lower slopes and adjoining small lowlands, the climate is hot and humid but does not have the high annual rainfall typical of the Pacific coastlands. It is more seasonal in character, with two well-marked drought periods. As a result there is a vegetation of tropical shrubs and grasses with patches of forest along the rivers. Small subsistence farms belonging to Indians are scattered throughout the region, mainly near streams. Those

who work on plantations cultivate crops of cassava and beans for their own needs in a crude fashion by scratching the ground with a stick, only tending plants at harvest time. Wandering Indians also gather products like balata and tagua nuts from the forest. Of the commercial timbers sought, mahogany is the most valuable. The better class Negro farmers raise cotton and sugar-cane on their farms, some of which are reasonably large plantations. As yet the production of cotton is small, coming from areas scattered along the lower Magdalena, where the soils and the marked wet and dry seasons provide excellent natural conditions. If exploited on a large scale, cotton growing could be of great economic significance in this region. Sugar-cane also has distinct possibilities in the Magdalena lowlands, especially near Cartagena, where there are suitable soils, rainfall and periods of sunshine. But droughts, plant diseases and pests, labour problems and lack of modern methods prevent expansion. On the higher parts of the plains and western foothills of the Santa Marta Range small Negro farmers have also developed one of the best banana-growing regions of South America. This was done under the initiative and direction of the American Fruit Company, which handles the general organisation and marketing. Rainfall was helped by irrigation at certain times of the year, when constant high temperatures, freedom from winds and cheap unskilled labour ensure high production. But unfortunately the diseases of recent years have reduced the plantations tragically.

At the higher levels on the Santa Marta slopes (between 3000 and 6000 feet), suitable conditions of soils, rain and dry periods have resulted in extensive coffee production. On the savannas of the hills and higher plains are the largest cattle estancias. These are well supervised and improved pastures have been planted. Here river transport makes possible the movement of stock, hides and cheese to internal and external markets. Away from these holdings, the lack of proper control, poor transport and many diseases and pests make good breeding and the extension of the cattle industry difficult.

The most important mineral resource of Colombia is petroleum, which ranks after coffee as the country's main item of export. As the map shows, there are several fields in operation in the central Magdalena Valley, and physical conditions point to many potential areas of oil flow. The most important fields at present are east of the Magdalena Valley, adjoining the Lake Maracaibo fields of Venezuela. A 400-mile pipeline takes the oil to tankers at Cartagena for export to the United States.

This northern region of Colombia owes much of its development to the major ports through which most of the imports and exports flow for the whole of the country. Each is in a good location for trade and over the years has developed certain specialised functions.

**4. Valleys and intermontane basins.** For the purposes of general illustration Figure 49 shows this region as being somewhat similar in structure to the highland regions we have seen already. Actually it is much more

complex, with a considerable variety of surface patterns. There are also the contrasts in climate and natural vegetation due to altitude and aspect, with their important relationships to the pattern of economic development and population spread. Dense forests occur in the hot humid valleys of lower elevation and here the subsistence farmers are found, but in the milder conditions existing between 3000 and 6000 feet, commercial production of tobacco and coffee appears, while above here to 10,000 feet it is possible to cultivate various grain crops like wheat and barley. Mountain pastures support sheep and cattle up to 15,000 feet on cold dry areas. Above these is the snowline. There is much subsistence farming throughout all these regions, both to provide food for people who labour on plantations and for purely sedentary natives in rough country like the Western Cordillera.

Coffee is the most important commercial crop, since it is the main export of Colombia and has a big demand in the United States because of its high quality and mild flavour due to the good natural conditions of climate, soil and drainage. The cultivated areas are small but the crop can thrive on steep land unsuited to other purposes and with little in the way of farming tools and equipment. This is a similar situation to that occurring in the highland of Venezuela. Coffee beans have the added advantage of storing and carrying well, since the transport to Caribbean ports is varied and often lengthy over very rough country. There is still considerable use of mules on trails, with trans-shipment to trains and steamers before the produce goes down the Magdalena.

Sugar-cane is grown widely on small farms for local use, but is confined mainly to valleys of lower elevation. The chief commercial production is in the Cauca Valley where the crop may be associated with other farming and coffee growing. This region also produces cacao, but erosion is bad throughout and the cultivation of basic food crops may even be neglected.

Tobacco is also raised on small properties, mostly in the upper Magdalena Valley and Eastern Cordillera. Of fairly high quality it is treated in local tobacco and cigar factories in such centres as Bucaramanga.

In the Cauca Valley where there are good natural and cultivated grasses, cattle and horses are bred on large estancias. The owners often live in the main market and transport towns life Cali. Pests and droughts affect expansion. In the upper Magdalena Valley, with its additional animal population of sheep and goats, grazing is the main occupation. Here the hindrances are poor stock and difficult transport to markets. This is especially so about Bogota. Stock do better on the high mountain pastures, where the climate is suitable and pests absent. They are supervised by individual and tenant farmers.

Colombia has considerable deposits of mineral wealth and these are valuable to industry. But again, transport hinders their being worked fully. Only those which are in greatest demand have been mined so far.

For example, gold comes from considerable lode mining and alluvial dredging in the Western and Central cordilleras. It has been a most important source of income since the days of Spanish discovery and Colombia is still one of the major producers of South America. This Republic has also led the world in emeralds for hundreds of years, but of late there has been a big reduction in the production of these precious stones because of a fall in demand. Most of them came from near the capital, Bogota. Here too, as also in the Cauca region, coal for local use is being mined. Platinum still comes from the gravels of many streams south of the highlands, but Colombia now produces only four per cent of the world output.

This Andean region of Colombia supports the majority of the population of the State for a number of reasons, among them being the favourable climate and the agricultural and mineral wealth. Further, there is a considerable interest in manufacturing, although Colombia is not by any means an industrial country; the localisation of certain factories means a growth in urban population. Good examples of this are seen in Medellin and Bogota, the two principal cities.

*Medellin* is an interesting example of tropical development by white people. It is situated on the western side of the Central Cordillera at a height of about 4000 feet and is the centre of a district known as Antioquia. From early times this has been distinctly different from any other part of Colombia. For one thing, the people have remained of almost pure European stock. Coming purposely to this isolated spot in the seventeenth century, they found few Indians and steadfastly refused to mix with them or introduce Negro slaves like their neighbours. At the same time they have always maintained a high birthrate. They were industrious and over the years by doing their own manual labour on farms and building up manufacturing and commerce, they gradually developed a unique settlement for tropical lands. Only with the advent of the coffee industry in the late nineteenth century did they begin to make active contact with the outside world. Apart from their agricultural and mining interests, especially in gold, the district now has thirty to forty cities with a population of over 10,000, with Medellin the most thriving centre of them all, noted for its wealth and for its modern amenities and cultural and educational institutions. Manufactures cover a wide range, mostly of textiles, foodstuffs, ironware and luxury goods. Former isolation has now been largely overcome by a series of new railways, roads and airlines.

*Bogota*, although second to Medellin as a manufacturing centre, is the seat of government. It is also the educational and cultural centre of the Republic and its National University was founded in 1572. Situated in a plateau basin at a height of 8600 feet in a dry, healthy climate, its greatest drawback is that it is 800 miles from the coast and has always been difficult to reach. Transport was costly and slow, as goods had to be handled many times when going or coming through the Mag-

dalena Valley. In recent years roads, railways and airlines have given it a number of valuable connexions. A railway is now being built to the port of Buenaventura on the Pacific Coast. The people in the surrounding district are mostly Mestizos and Indians, but in the city itself the inhabitants are mainly of Spanish descent.

**5. The Llanos.** As the map (Figure 51) indicates, these take up a large part of the area of the country. Unfortunately they are not of much economic value, for the northern section produces little but horses and poor quality beefstock and is sparsely populated. The south merges into forest lands containing valuable timbers and rubber, but is peopled by a few wandering Indians. The climate is unattractive and this, with the bad living conditions and disease, deters settlement. Any future development will have to cope with transport because of the Andean Cordillera on the west and the great distance from the sea to the north. At present there are no roads or railways excepting one line to Bogota from the Meta River district; the rivers are unreliable for transport because floods and droughts make for intermittent flow in them.

## Ecuador

This small republic of about 100,000 square miles has this name since its lies across the Equator, for which the Spanish word is "ecuador". There are many natural resources which can be used for outside trade, but altogether it is a poor country. Population is small, being about 3½ million, mostly in the uplands. The people are made up of several distinct racial groups and many of the problems relating to the future development of Ecuador are bound up in their opposed views. Thus the large Indian group, who are mainly self-sufficient farmers, living in the uplands, are not really interested in commercial development and trade. But the Mestizos of the coastal lands are vigorous and keen on economic progress. The remainder are small groups of Spanish and Negro ancestry, the former being chiefly responsible for Government administration. Because of the conflicts and disunity which have arisen over the years, a leading place in the cacao markets of the world has been lost, the other tropical products of the plain are not fully exploited, and upland agriculture is still primitive. Transport is not as free or efficient as it might be, and land to the east, which could have been opened up in future years by using the headwaters of the Amazon, has now been lost to Peru. Nevertheless, the background to the human and economic difficulties is related in no small way to the physical structure of the land. As in Peru, there are three main divisions, the coastal plain, mountains and plateau, and eastern slopes.

**1. The coastal plain and foothills.** The plain has an average width of about 80 miles of low plain which merges into rolling hills of 2000 feet elevation north of the gulf and west of the city of Guayaquil. From north to south

appear remarkable changes in climate and vegetation. For example, in the north the constant high temperatures and humidity and double maximum rainfall produce selva. Coming south, the temperatures are maintained, but the rainfall gradually diminishes, until south of the Gulf there is a marked deficiency and the beginning of the great desert strip along the west coast of South America. This means a corresponding change in vegetation from semi-deciduous trees to scrub, savanna and then desert types. The Guayas River, flowing north, is the only stream suitable for navigation and transport.

In the northern area of the plain, Negroes carry on shifting agriculture and prospecting for gold. Farther to the south, Indians have permanent farms with some cacao and other plantations. The main commercial production is of cacao and tagua nuts gathered in the upper Guayas Valley. These are used for making buttons and imitation ivory ornaments. From the fibres of the toquilla palm, Indians weave the famous Panama hats, so-called because that was the port in Central America to which they were sent for export. It is on the Guayas lowlands lying between the coastal hills and the foot of the Andes, where high temperatures, rainfall and humidity occur, that some of the most important export crops flourish. Rice is grown extensively on the more marshy land, to supply peasant and city needs, and there is an important export trade. Cacao is still the chief crop and was once the leader of the world by reason of its quality, but it lost its place to the Guinea Coast of West Africa. This was due mainly to absentee owners, careless managers and the rise of a number of diseases. Considerable coffee appears on the Andean slopes and coastal hills, but it is not yet of good quality. Cattle are grazed on the slopes in the wet seasons and return to the river flats in the dry seasons. Fruits are grown extensively and exported to Peru, Chile and the south.

**2. The intermontane basins** consist of a series of some ten basins lying for the most part in a large rift valley about 300 miles long and 100 miles wide. This has developed between two major cordilleras of the Andes from which a number of transverse ridges project to form the divisions between the basins. The floors and sides of these depressions have been covered in the past by volcanic ash from a number of giant active volcanoes developed on the edges of the rift. They are among the largest in the world, the highest being the famous Mount Chimborazo (20,000 feet) and Mount Cotopaxi (19,000 feet). Although they are very close to the Equator, their upper slopes are snow-clad.

The average height of these highlands is 9000 feet and being situated about the Equator, they have some interesting climatic features. Thus the mean monthly temperature at Quito is springlike in character and there is almost no seasonal range. The mid-day position of the sun changes little during the year, throughout which daylight and darkness are equal in length. There are virtually no seasons, but there are considerable variations in the day and night temperatures and the daily weather. Night

and early morning are generally cold and clear with frost, but as the day goes on, temperatures rise quickly to produce cloud and thunderstorms in the afternoon, when hail and rain are frequently accompanied by snow. September to May is the rainy season, with the following three months dry. Altogether, the climate is healthy and invigorating, but bleak.

Forests are found on the mountain slopes up to 10,000 feet, but in the basins the natural vegetation is mainly dense bush which has grown on the porous ash soils. In the clearing of this for pasture lands the plants have been used for the making of charcoal. The chief subsistence crops grown by the Indians on their small farms are potatoes (this is said to be their original home), barley, wheat and maize. On the high grassy paramos are large haciendas rearing cattle, sheep and horses, mostly for trade. They are taken out over mountain trails to be fattened on the lowland pastures before being sold.

On the whole, Ecuador supports a relatively dense population, but it is not as important commercially as the lowlands. The difficulties and primitive type of much of the transport, the division into separate basins, and the lack of larger mining and manufacturing enterprises, do not promise much for the future.

## EXERCISES

1. **Vocabulary words and phrases:** intermontane basins, montana, guano, paramos, vicuna, poncho, hacienda, estancia, balata, tagua nuts.

2. Describe the agricultural methods used and the crops and animal products produced on the highlands of Peru and Colombia.

3. Describe carefully the development of oasis cultivation in Peru, noting any differences in the different parts of the country.

4. Contrast the landforms, economic development and population of the coastal lands of Peru, Ecuador and Colombia.

5. List the geographic reasons which have helped to make coffee the most important cash crop of Colombia.

6. On a map of the North Andean States show the location of the major cities. Give reasons for their sites and list the special functions of each. Note especially the development of seaports.

7. Compare and contrast the development of the North Andean States of South America and the Barbary States of Africa. Explain any important points of difference you may notice.

8. Using the population distribution map (Figure 47) explain the varying population densities shown on it for Colombia, Peru and Ecuador.

9. Discuss the general importance of minerals in leading to the development of the Peruvian Andes. Do not forget to include the Inca civilisation in your answer.

# CHAPTER XVI

# VENEZUELA AND THE GUIANAS

## Venezuela

Venezuela was the first part of South America actually settled by the early Spanish explorers in the sixteenth century. Noting Indian villages built on piles over the water in Lake Maracaibo they called the place Venezuela or "Little Venice". From here they moved inland in search of gold after hearing legends of El Dorado. Little of the precious metal was found, but the land subsequently proved excellent for tropical agriculture, especially since sugar and cotton were so valuable in those days and slaves could be had to work the plantations. Later, coffee and cacao were added as crops and these four commodities remained the basis of the country's economy until the momentous discovery of petroleum some 40 years ago.

With an area of about 350,000 square miles, Venezuela sprawls across the north and north-west of South America to touch the Caribbean Sea. Its physical structure is determined largely by the relations of the northern extensions of the Andean system to the coastline and the northern interior lowlands. As we saw before in Figure 35, when the main cordillera reaches these areas of the continent it divides into three major branches or arms. Two of these partly embrace the Maracaibo lowland, which is relatively wide and contains a large saltwater lake, while the third, known as the Sierra de Merida, continues eastwards more or less parallel to the coastline. It breaks into two ranges which decrease in height and become broken into sections before they emerge from the sea to form the large island of Trinidad. The result is to divide the country into regions of coastal plain, plateau and mountain, and wide interior lowlands drained by the Orinoco River and its tributaries. The remaining section in the extreme south is a portion of the old plateau block of the Guiana highlands. This then is the basis of the regional division shown in Figure 50.

Climatically the low latitudinal position produces constant high temperatures and humidity on the lowlands, with a very small annual and diurnal range. Hence the importance of the uplands in determining the location of the major settlements in the country. Rainfall is fairly heavy with a double maximum in May-June and September-October. As the winds come mainly from the east, there is more rain on the seaward-facing slopes than on the lowlands they shelter.

**1. Number 1 Region (Figure 50). The Maracaibo Lowlands.** These are fairly extensive and surround a lake some 6000 square miles in area. It

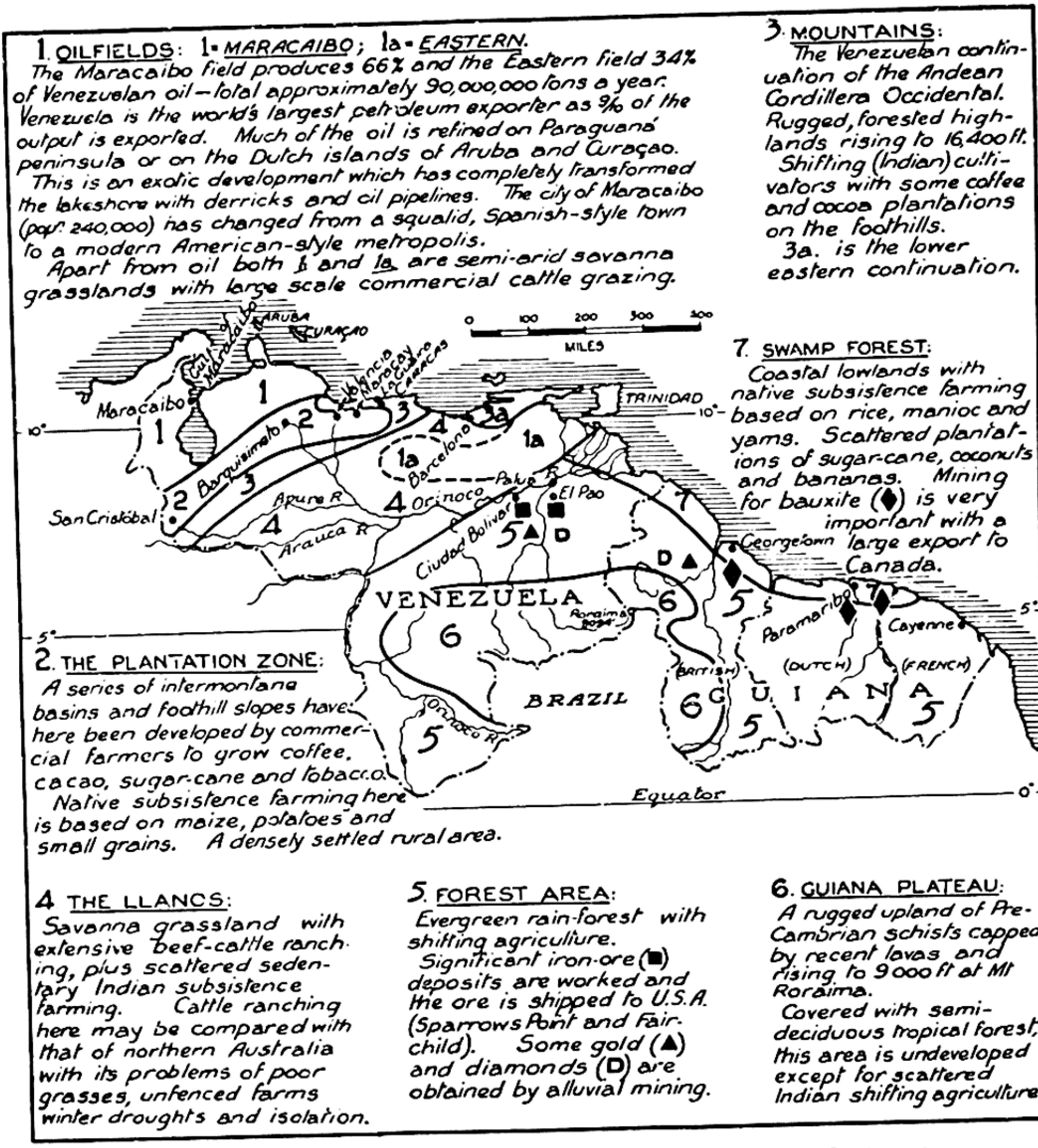


FIG. 50. *Map-summary of the geography of northern South America.*

is joined to the Caribbean Sea by a shallow entrance from two to eight miles wide.

Heavy rainfall and high humidity have developed selva over much of the area, so that it is regarded as one of the most oppressive environments, the more so since surrounding highlands keep out winds. Cultivation was limited for years to the production of cacao and sugar-cane, while excellent coffee was grown on the adjacent eastern uplands. As a result it was one of the poorer regions of Venezuela. The discovery of petroleum and the development of the industry by foreign enterprise has had some remarkable results, as is noted on the map. The royalties paid to the Government have made possible a large programme of public works to relieve the squalor and poverty of earlier years. Under recent

legislation oil companies have agreed to employ 75 per cent Venezuelans in the industry. This they now do, although mostly in the capacity of labourers and clerks. The managerial personnel is foreign and almost all supplies are imported.

Plantations still flourish, with Negroes as the chief workers; and in the drier areas, where lower rainfalls produce savanna lands, beef cattle are important. Like the rest of Venezuela, the population is mostly Mestizos, though there is a concentration of Europeans in urban centres like Maracaibo. Native Indians are found only in the western jungles, where they still follow sedentary or migratory subsistence farming.

It will be noted on the map that Region 1(a) is also classed as an oil and cattle producing area, although it is not part of the Maracaibo lowlands, but an extension of the Orinoco lowlands through a break in the coastal ranges. Its inclusion with Number 1 region was on the grounds of its oil production.

**2. Number 7 Region. The Northern Coastal Plain** is included here since it is another coastal lowland, although it is not nearly so economically significant as the similar area in Guiana, which will be discussed later.

The Venezuela plain is narrow, and much of it is taken up by the great Orinoco delta, with its maze of distributaries, forested islands, mudflats and swamps. The sea invades much of the area to produce stinking mangrove swamps, since it is largely below sea-level. These features, combined with an oppressive climate, make an unattractive environment in which only native peoples have settled on the higher ground where some agriculture is possible.

**3. Number 2 Region. The Plateau Zone of the Central Highlands** has a rather complex structure. In general it consists of a number of basins lying between ranges of the main Andean system, which here continue to the the sea at heights of between 7000 and 9000 feet. Temperature decreases with height and there is abundant rain, especially on upper slopes facing the sea. This results in forest cover to considerable heights. In the sheltered basins with lower precipitations the natural vegetation is a mixture of scrub forest and savanna. The two best-known basins are those of Valencia, lying at an elevation of 1500 feet, and Caracas, at an altitude of 3000 feet.

(*a*) *The Valencia Basin* was settled at an early period by the Spanish conquerors, who took advantage of the cheap land, plenty of ground water, well-drained slopes and local slave labour to cultivate sugar-cane, cacao and tobacco. Today this region is still the chief agricultural area of the country, supporting a dense rural population as well as a large city. The type of agriculture has changed considerably, although sugar-cane is still the main crop. Cotton is increasing in importance to supply the textile mills of Caracas, Valencia and Maracay. Valencia has been the main centre of the Venezuelan cattle industry for 300 years, many stock being brought from the llanos to be fattened and killed there.

It is outside such basins, on the slopes and valley bottoms of the wet eastward-facing ranges, that the large plantations of cacao and coffee are now found. Coffee in particular has become the most important export crop. It is of excellent quality and produced cheaply on the steep hillslopes.

Native subsistence farming here is largely a hoe culture based on beans, rice, bananas, potatoes and maize. These people occupy land useless for commercial plantations, and they cultivate the steepest of slopes.

(*b*) *The Valley of Caracas* is the most densely populated rural area in Venezuela, but most of the farmers here obtain part of their income from work in the city. Caracas has grown from a rather dingy town to a modern metropolis of some 700,000 population. Both it and Valencia are connected by railway and highroad with La Guaira, the seaport. The related highlands to the east of the central region have not shown much progress and are inhabited mainly by subsistence farmers. Recent discovery of oil in this area has led to a rather rapid development of oilwells and pipelines to coastal ports.

**4. Number 3 Region. The Sierra de Merida Mountains** are part of the main Andean Cordillera that forms the high south-western end of the Venezuelan uplands. They rise to over 16,000 feet and have permanent snow on a number of peaks. They show the marked vertical zonation of climatic and agricultural features characteristic of tropical highlands. Up to 3000 feet is a belt of hot country with an average annual temperature between 75° and 80° and a small annual range; this is the "tierra caliente" and is the zone of tropical agriculture. Above this and up to 6000 feet are the cooler slopes and valleys of the "tierra templada", where temperatures range from 65° to 75°; these are the coffee lands. Above them and up to 10,000 feet lies the "tierra fria", where temperatures are between 50° and 65° and small grains and potatoes form the major farm products. Finally, there are the "paramos" or alpine meadows, which reach to the snowline at 15,000 to 16,000 feet.

The mountain lands are generally very rugged, with a series of isolated intermontane valleys mostly having difficult access to the coastal regions and seaports. The isolation has suited the native Indians, who live mainly in the "templada" zone, where two crops of their basic food, maize, are possible each year. Early European farmers were hampered by the difficulty and cost of transport to outside markets, but these were gradually offset as the coffee plantations of the foothills became the chief producers of Venezuela. Today these farms are linked to the ports by both railways and good macadam roads.

**5. Region Number 4. The Orinoco Basin** has been the traditional home of the cattle industry for over 300 years. Even today the land is mostly held in huge ranches called hatos and owned by people living in the comfort-

able climate of the Valencia Basin, to which the cattle are sent for fattening. The ranches are worked by groups of semi-nomadic cattlemen known as llaneros.

The region consists of a great plain sloping gently from the foothills of the Andes to the Orinoco River. It is about 200 miles wide by 600 miles long, with a surface broken by wide river valleys separated by flat watersheds. The climate, which is its main distinguishing feature, consists of two well-marked seasons: a hot rainy one followed by a hot dry

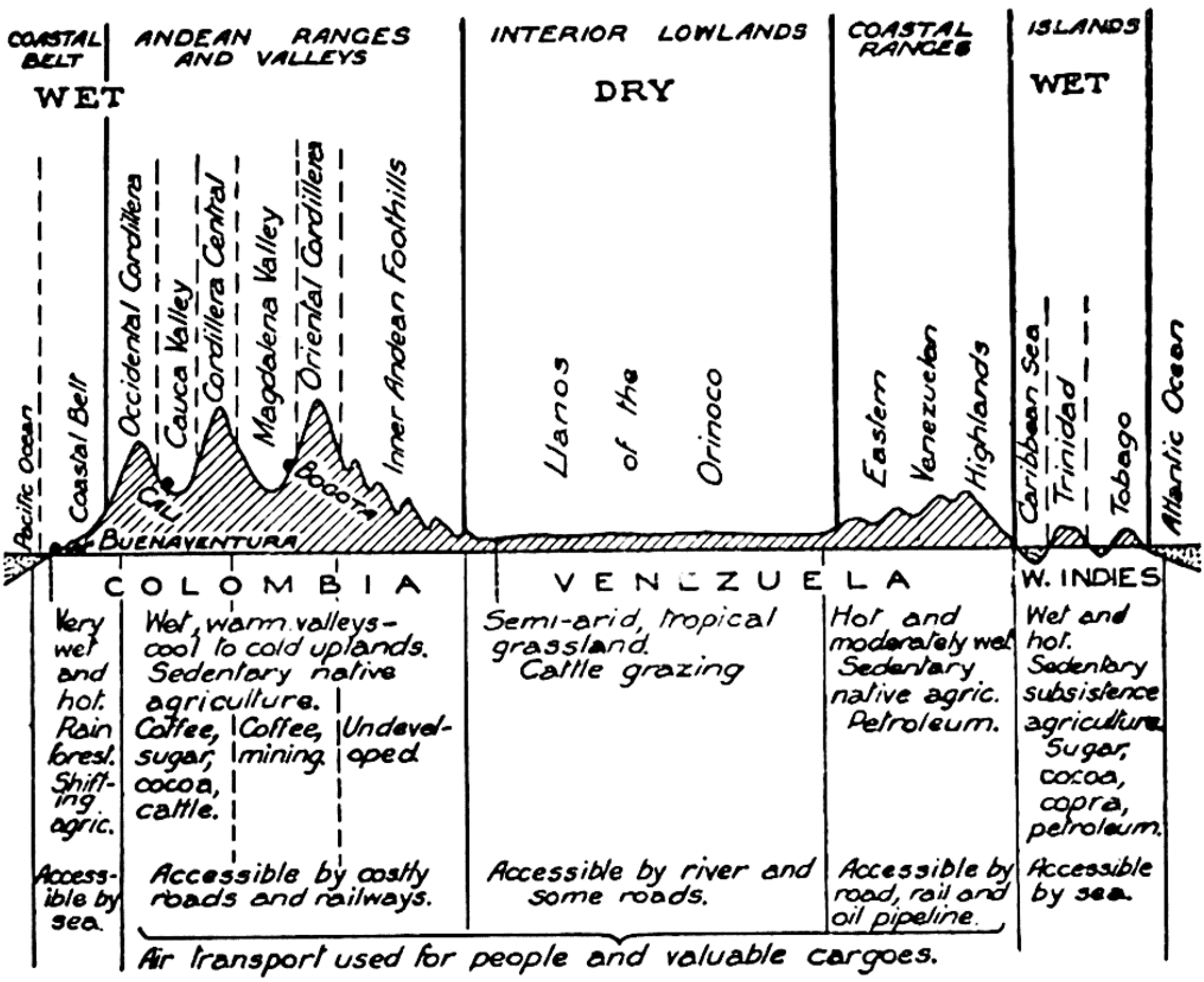


FIG. 51. *Transect diagram across Colombia and Venezuela.*

one. The rainy season, lasting from June to October, brings flooding over vast areas of lower ground, causing the cattle to be moved to the higher interfluves. The dry season brings water scarcity and turns the grasses rank and inedible. Cattle feed now is obtained only near streams and by burning off the dead grasses in advance of early rains. Under these conditions of poor supplies of low-quality fodder the cattle barely manage to survive. Added to this are the lack of shade from trees that shed most of their leaves in the dry season and the presence of innumerable insect pests to plague man and beast.

This is really poor pasture country similar to much of that in the

inland of northern Australia. It can produce only low-grade beef animals under conditions of open-range grazing in a land where only the toughest animals can survive. As in Australia, attempts have been made to improve the quality by importing heat- and tick-resisting Zebu cattle. In general the industry is still conducted on the traditional lines and is mostly uneconomic. This does not trouble the Venezuelans, who have practised the industry for so long that it has become a definite way of life in the country.

The cattle are marketed, mainly for beef, tallow and skins, through Valencia and the port of Puerto Cabello.

**6. Region Number 5. The Forest Area** is marginal to the coastal swamp-forest and continues southwards into the Guianas. Much of the land is very hilly and it finally gives way to rugged plateau scarps in the south. The evergreen forests contain many valuable timbers, but because of lumbering difficulties, only a few of them are exported. Greenheart, a very hard and durable timber, is the main one cut. The inhabitants are mostly Indians, who practise typical forest subsistence agriculture.

For many years gold and diamonds have been obtained in quite large quantities by the washing of alluvial gravels; large-scale shaft mining was once important, with the mine at El Callao the most important in the world. Even today it is still the main producer in the State. Recent prospecting for mineral ores in this region has revealed large rich iron ores in the Ciudad Bolivar district. American interests have developed the ore bodies at El Pao and Cerro Bolivar, and some two to three million tons a year are exported via the Orinoco River to steel-works near Baltimore and Philadelphia. The ore is mined by quarrying. The labour is recruited locally and is directed by American engineers and overseers. The reserves are immense, and the industry has some semblance of permanency.

## The Guianas

**7. Number 6 Region. The Guiana Plateau** lies along the southern edge of the region. It consists of ancient rocks severely dissected and flanked by a cliffed scarp up to 3000 feet in height. The plateau rises to 9000 feet at Mt Roraima. Most of it is covered either with tropical forests or with grassland similar to the llanos. Its isolation and difficulty of access, together with its rather unattractive physical features, have prevented settlement beyond an occasional mining town.

The Guianas are the only part of South America under foreign governments; they are owned by the British, French and Dutch. They represent a gap in the lands occupied in the first instance by the Spaniards to the west and the Portuguese to the east. That they were never taken over or settled by these two powers would seem to be because of their physical aversion to the country, particularly to the difficulty of penetrating the forests there.

The name Guiana comes from an Indian word meaning "watery country", and this is an apt description of the coastal districts at least. Here the country consists of coastal lagoons and mangrove swamps with a typically equatorial climate of high rainfall, high temperatures and high humidity. Some relief comes from on-shore north-east trade winds, but the area is riddled with malaria, yellow fever and dysentery.

The Dutch, who began colonising here in the middle of the eighteenth century, were able, because of their long experience at home, to build sea walls and drainage ditches to reclaim land from the lagoons. The soils proved fertile and plantations of sugar were developed along the narrow coastal plain with the help of Negro slave labour. The English established their farms on the higher sand and clay belts above flood level. Today they have also reclaimed lands, with large estates producing sugar-cane, cacao and coconuts with imported Asiatic labour as well as small farms growing tropical subsistence crops. The Dutch now grow sugar-cane, coffee and oranges on their coastal farmlands, while the French have the same crops on smaller and poorer plantations. Two interesting features of the agricultural areas are the special interest in rice for the imported Asiatic labourers and the use of canals in sugar production. Originally developed by the Dutch, they are so constructed as to provide drainage in the wet season, irrigation in the dry season, and transport for the harvested crops at all times.

The hinterlands are high, rugged and heavily forested, with some savannas occurring far inland on the southern borders. Many of the streams tumble off the plateau escarpment in magnificent waterfalls which offer a possible hope for future hydro-electric power. The best-known of these are the Kaieteur Falls, with a drop of 740 feet. These forested areas produce cabinet timbers and small amounts of gold and diamonds. Nearer the coast, in Surinam and British Guiana, are enormous areas of bauxite, which is now being actively exploited by American interests and exported to Canada and the United States for manufacture into aluminium.

From an economic point of view, French Guiana is the most backward State, its two main bids to fame being cayenne pepper and a large prison population, including that at the notorious Devil's Island.

The British and Dutch possessions have managed to enjoy some periods of stability, but unsteady markets for tropical products and an inadequate labour supply are two main problems. The importation of labourers from abroad has resulted in an extraordinary mixture of peoples throughout the area, with attendant social problems. Thus, British Guiana with a population of 470,000 had three per cent whites, while Surinam with 240,000 people had four per cent. Of the very mixed remainder the proportions are roughly:

British Guiana: 42 per cent East Indians, 38 per cent Negroes, 12 per cent mixtures, 3 per cent Indians.

Dutch Guiana: 28 per cent Negroes, of whom all but a quarter live in the forests, whither their forebears escaped from slavery, 30 per cent East Indians, 2 per cent Chinese.

Many of these people in both States came over under contract but now will not return to their native lands. This has not only added to the problem of unemployment but has raised questions of food supply and housing. Symptomatic of these things is the increasing political unrest, especially in British Guiana, and the agitation for certain colonial reforms and greater constitutional freedom.

## EXERCISES

1. **Vocabulary words and phrases:** tierra caliente, tierra templada, tierra fria, llaneros.

2. In Figure 51 (page 151) a new method of summarising the main geographical features of a region was used. It should be studied in relation to a good map of the area and the two map-summaries on pages 133 and 148.

Using those map-summaries and a good physical map (such as in the *Oxford Atlas*) draw transect diagrams:

(a) from Cayenne (French Guiana) along the 5° N. parallel of latitude to the Pacific Ocean.
(b) From Cartagena to Caracas.
(c) Along the 75° W. meridian from Barranquilla to Lomas in Peru.
(d) From Arequipa (Peru) to Georgetown (British Guiana).

3. Compare the geographical features and their development by man of South America north of the Equator with that in Africa north of the Tropic of Cancer.

4. Examine the reasons why Colombia is still somewhat backward after over 400 years of European occupation.

5. Compare and contrast the development of the savanna grasslands of Venezuela with those of Nigeria and northern Australia.

6. Describe carefully the llanos environment and indicate why the raising of beef cattle is not of great importance there.

7. Discuss the development of plantation agriculture throughout the Caribbean hinterland of South America.

8. Compare the life of an Indian inhabitant of the forests of Colombia and Venezuela with that of a Negro in the forests of West Africa.

9. Using the North Andean States as an example, examine the effect of European occupation on the lives of Indian peoples in South America.

# CHAPTER XVII

# BRAZIL

## Landforms

Brazil has an area of approximately 3,300,000 square miles, which makes it the largest country in South America, taking up some 45 per cent of the continent. Comparatively, also, it is larger than the United States or Australia and is in fact one of the five great countries of the world. At the same time, the greater part of it is undeveloped, and outside the polar regions it has the largest unexplored areas.

Although Figure 52 shows a number of physical divisions, there are, broadly, only three, the highlands (including part of the Guianas), the lowlands and the coastal plains. As we have already described these in some detail (see Chapter VIII), it is not proposed to say more about their physical geography beyond referring to some aspects that have a special bearing on our discussion below.

Brazil is not a land of high mountains, such uplands as do occur being made up mainly of a large plateau block tilted to the west. Scarp edges developed on its surface and margins are sometimes referred to as ranges. Those in the Mato Grosso act as drainage divides or watersheds. Actually, the surface is considerably broken towards the west by erosion from stream headwaters. Again, the ancient nature of many of the rocks has made possible certain mining and industrial developments. A variety of soil types has combined with climate to encourage certain specialised agricultural pursuits. Furthermore, the extent of elevated land in tropical zones has so modified climatic circumstances as to permit unique forms of occupance and economic development. The lowlands, too, are of special interest because they contain the three great river systems of the Sao Francisco, Parana and Amazon, each with distinctive features relating to the respective sizes of their basins, annual regimes and navigability, and possible contribution towards settlement. The coastlands bordering the scarplands of the east and south-east are narrow and not a continuous plain. They have several very good harbours which act as market centres and ports for the products of plateau and plain. To the north-east and north they gradually widen and become marginal to the great equatorial lowlands.

## Climate and Vegetation

The climatic circumstances are determined in large measure by the physical structure of Brazil and its latitudinal position, since the bulk of the country lies between the Equator and the Tropic of Capricorn. In

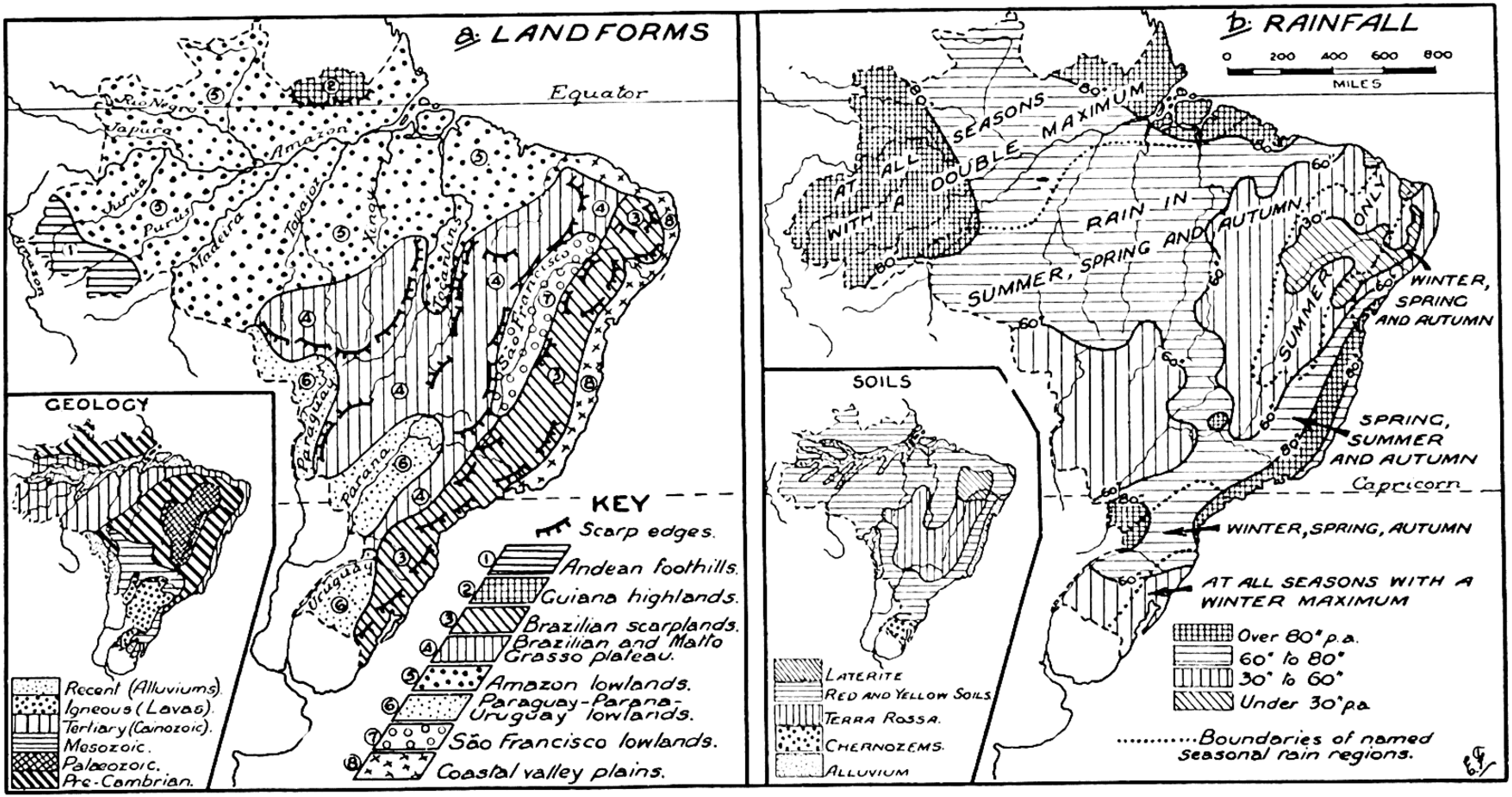


FIG. 52. *Landforms, rainfall distribution and soils of Brazil.*

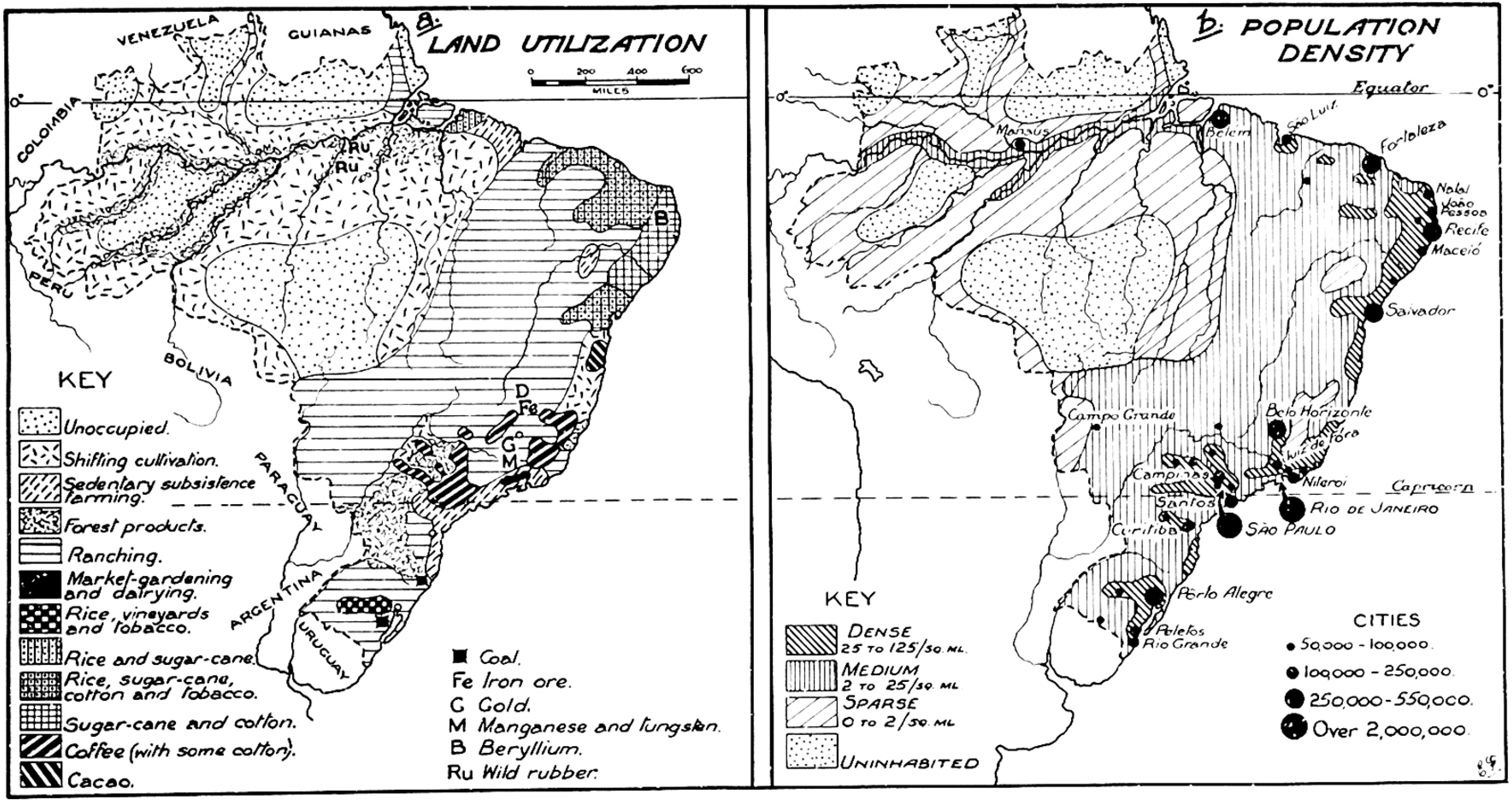


FIG. 53. *Land utilisation and population distribution in Brazil.*

general the rainfall map (Figure 52) shows that much of the country receives between 60 and 80 inches per year with summer maximum except in the Amazon Basin and the south-east, where there is rain at all seasons. Of special interest are the areas of much lower precipitation, with frequent droughts in the north-east and Sao Francisco Valley. As a result this particular region has only a vegetation cover of tropical scrub and associated grasses, whereas the bulk of the plateau surface has savanna grasslands and woodlands. With increase in rain and temperature these give way to tropical and equatorial rain forest.

### Economic Development and Land Use

Brazil has a variety of geographical environments, which are grouped in a general fashion into several major regions.

The great central plateau consists mainly of rolling topography and high plains, broken by deep valleys and scarplands forming ridges. This is capable of relatively easy development, but it has poor communications and carries only a sparse population.

To the west of this upland are swampy lowlands which eventually merge into the vast selvas of the Amazon Valley, a region of vast resources, but offering insuperable difficulties to development.

Southwards are the undulating temperate lands, with good rainfall and adjacent to the south-eastern scarplands, and sufficiently high to temper the climate. These are the areas of greatest development and densest population.

To the north-east are the drought regions, where the planned use of water and other resources of the Sao Francisco River Valley may produce the next biggest advance in Brazil's agricultural and industrial development.

Finally we have the coastal plain extending from approximately latitude 29° south to the mouth of the Amazon. It is generally well watered, and, with a fair proportion of alluvial soils and a tropical to equatorial climate, it has an important production and population spread, with distinct possibilities for the future.

### Land Utilisation

Bearing the above in mind, we are not really surprised therefore to note on the land utilisation map a tremendous variety in the production of foodstuffs, raw materials for industry and animal population. At the same time we must notice the marked contrasts in their actual distribution. Thus there are enormous areas virtually unoccupied; they are given over to purely subsistence pursuits or sparsely taken up by pastoral activities. As against this there is the most intensive occupance associated with specialised farming, especially that associated with tropical plantations. In connexion with this fact, it must be remembered, of course, that commercial agriculture does not concern as many people as the self-

sufficient types of farming carried on by natives and peasant peoples. This has a certain special significance in regard to land tenure and standards of living, mentioned earlier in the general land survey of South America as a whole. Future implications of this will be discussed in the study on population.

**1. Coffee** is the most important agricultural product of Brazil, which now provides nearly half of the world's total, stresses high-quality beans and still has the most extensive areas available for cultivation. The chief producing State is Sao Paulo, which has the ideal conditions of well-drained tropical slopes, deep rich soils, suitable rainfall and temperature and the absence of frosts in the winter months. When the sunny weather from May to September permits drying of the beans in the picking season the fazendas (plantations) are invaded by an army of migrant workers. The bagged beans eventually go to the State capital, Sao Paulo, whence they are railed to the chief port of Santos. The United States takes a large amount of the coffee produced, and exports of it actually earn more than twice as much as all the other exports together. For some years over-production led to a fall in world prices, and this meant the destruction of some crops as well as the bringing in of legislation to prevent extension of planting together with the breaking up of some of the large estates. The smaller farms are worked by peasants, who cultivate cotton, maize, sugar-cane and citrus fruits in addition to the coffee.

**2. Cacao.** Brazil produces nearly one-fifth of the world's cacao, and it is the country's second export. As the plant requires a warm, humid and generally uniform environment throughout the year, as well as shade and protection, especially for the young trees, the chief plantations are along sheltered coastal plains. Production areas are principally round Salvador, which is also the chief exporting centre.

**3. Sugar-cane, tobacco, cotton and rice.** Although the key to Figure 53 shows these as being grown in various associations with each other, some significant details of each are worth our notice.

(*a*) *Sugar-cane* was first grown successfully round Salvador and Recife by early Portuguese settlers using Negro slave labour. With about one-eighth of the world's production, it is an important crop. Recife is the centre of refining and there is a growing export to western European markets. Recently there has been some contraction of the sugar-cane area as some of the drier parts have been taken over for cotton growing.

(*b*) *Tobacco* was another crop introduced by the same colonists to the same regions, and for many years it was a leading product. Although much of the land is nowadays shared with other agriculture, Brazil specialises in the quality of its leaf for cigar-making. The main tobacco districts are in the States of Rio Grande do Sul, Minas Gerais and Salvador.

(*c*) *Cotton* appears throughout all the eastern regions of Brazil as far south as Sao Paulo, there being considerable production there and in the north-east. Area under crop has increased to six million acres over the past 20 years and the production has now reached over 350,000 tons a year, which is approximately equal to that from Egypt. This is five per cent of the world total and experimental stations and the extension of irrigation have helped to make it of high quality. Tree cotton is cultivated in drier regions for its strong fibre which is used mainly by motor-tyre manufacturers. Manufacture of cotton textiles is carried out in Recife, Salvador, Sao Paulo and Rio de Janeiro.

(*d*) *Rice*. Practically all the land in Brazil can be used for growing rice, and yet it is curious to note that in 1917 Brazil was still importing this commodity. It is now an important supplier to international markets. Considerable research has gone into improving and cheapening the product while increasing its popularity in the consuming markets, e.g., that grown in the far south is favoured in Argentina and Central America. The chief producing States are Sao Paulo, Minas Gerais and Rio de Janeiro.

**4. Other farm products.**

(*a*) *Vineyards*. Over 80 per cent of the vineyards of Brazil are located in the south, in the Rio Grande do Sul, where the elevation and soils have proved eminently suitable for the cultivation of grapes. The extension of new varieties into the uplands (3300 feet) of Minas Gerais, which has volcanic soils, promises to produce the finest wines in Brazil.

(*b*) *Market gardens and dairying*. As is the case in most countries, these two activities have a close association with large urban districts, which need daily supplies of fresh vegetables and whole milk. An interesting feature is that many dairy cattle are imported from Holland. Those supplying the principal centres of population are kept in sheds and the use of hay and silage for feeding them is spreading.

(*c*) *Ranching*. Stock-raising, apart from being one of the principal factors in the growth and settlement of population, is a cornerstone in the economy of Brazil. Much work has had to be done in raising the standards of the herds and eliminating the causes of diseases. Despite this the herds are not yet of the same quality as those of Argentina. Pure-bred stock is imported regularly for acclimatisation purposes and renewing the strains. The Zebu or Brahmin humped cattle native to India have gone far to improve the Brazilian herds because of their great resistance to disease. This experiment might well be compared with what we have done in this regard by bringing new strains like the Santa Gertrudis into the beef-cattle lands of northern Australia.

With about 46 million head of cattle, Brazil is one of the major meat-producing countries. This can be attributed largely to the fact that the natural pastures of the country are fairly rich and extensive. There are

the prairies and savannas in the southern Amazon Basin, as there are also in the north-eastern, central and southern regions. The most important are those of Rio Branco (Amazonas), Marajo (Para), the Sao Francisco Basin, the Mato Grosso, and finally, the most famous of all, the prairies of the Rio Grande do Sul in the south, where pastures are especially good. It is here, too, that the best quality wool-sheep and breeds of horses are raised.

(*d*) *Forest products.* Although the map shows us that these come mainly from the more accessible parts of the Amazon waterways, the timber supplies of southern Brazil are very valuable. The most valuable is the famous Parana pine, which is exported in considerable quantities to Argentina. In the equatorial areas Indians may gain a meagre livelihood by collecting for European traders such produce as Brazil nuts, cinchona (for making quinine), oil seeds (for margarine and soap) and wild rubber. The last named comes from the hevea tree, which can be tapped only in the drier seasons because of the danger of flood waters. The timber of the Amazon forests has yet to be fully exploited. Some hardwoods and cabinet woods are taken out for export mainly to North America, but difficulties of handling are great and even now the main methods are to make the lighter woods into rafts to carry the massive timbers which are too heavy to float.

**5. Shifting cultivation and unoccupied lands.** As we have seen earlier, the extent of the river waters, the enervating climate, and the density of the jungles in the Amazon region would make any settlement on a large scale difficult. Thus, although there are important trading and transport centres like Manaos and Iquitos, the greater part of the population consists of wandering Indians. Some engage partly in hunting and fishing, while others attempt some small plantation cultivation of cacao, sugar, maize, rice and tobacco. Cassava roots, from which tapioca is made, constitute one of the main items of their diet. As the population is so small and so scattered it is easy to classify large areas as being literally unoccupied.

**6. Minerals.** The mineral wealth of Brazil is enormous, but it is not conveniently situated in terms of processing and transport. In the early stages of the development of the country, gold and diamonds were important, being mined on fields inland from Sao Paulo and exported through Rio de Janeiro. Today gold is not so important, but it is still an object of considerable activity on the part of thousands of independent miners occupied in prospecting and panning by primitive methods in various parts of the country. Four-fifths of the total production of this metal comes from a large modern mine in Minas Gerais. Diamonds, together with many other precious stones, especially sapphires and emeralds, are still found in this same area. It is the State of Bahia which has the greatest production of industrial varieties.

The greatest mineral resource of Brazil lies in its iron ore. Enormous

deposits of very high grade ore lie in certain districts of Minas Gerais (in the eastern watershed of the upper Sao Francisco River), the Mato Grosso and north of the mouth of the Amazon. Although these ores are easy to mine, they are difficult to reach and handle with present transport facilities. Added to this, such coking coal as is available, mainly in Rio Grande do Sul and Catarina, is not of very good quality. At the moment the main mining of iron ore and limestone is at Itabira and the most important smelting centres are at Volta Redonda and Santa Barbara. Their production of steel rails and shipbuilding materials for Rio de Janeiro shipyards are of special interest in view of the pressing transport problem of the country.

The production of manganese and tungsten in Minas Gerais is also affected by transport problems, which make the price too high. This is unfortunate, since the manganese ores have a very high content and rank among the largest deposits in the world. There are also large reserves of bauxite, but their exact size has not yet been calculated. A fairly wide range of other minerals has been located, the most significant of which are silver, lead, nickel, mica, asbestos, titanium, zirconium and beryllium. The last named is of special interest because of its increasing use as an alloy of copper to increase tensile strength and durability in such mechanisms as springs in electrical devices.

In spite of the abundance of agricultural and mineral raw materials, Brazil is handicapped considerably by her lack of petroleum. To date almost all such fuel has had to be imported. Extensive exploration is being carried out, and there is good reason to believe that there are considerable reserves of oil in certain regions, since amounts have been located in the State of Bahia. One factor said to be hindering exploration is the Government's opposition to foreign capital being involved in the work.

Poor coal reserves and lack of oil for fuel are offset by the vast potential of hydro-electric power to be harnessed on the great rivers of Brazil. Even now most of the country's generating capacity is obtained from water power. (Incidentally, most of the present domestic fuels and power are obtained from wood.) The most ambitious scheme is the construction of a large generating plant at Paulo Alfonso, on the Sao Francisco River, which has been called "the Nile of Brazil". The final success of this project should have tremendous results. The supply of cheap and abundant electricity to the north-east will eliminate the fear of constant droughts there, open up many new industries and prevent the periodic emigration of destitute thousands southwards towards urban areas.

## Transport

In the final analysis poor transport and the lack of it have been the most significant factor in preventing Brazil's full and proper development. The regions of higher populations, i.e., the south and north-west,

are reasonably well served with railways. Elsewhere only a few tentacle lines reach out from the populous seaboard to the interior. Plans are in hand for the extension and improvement of this rail system, including the electrification of lines, seeing that so much power should be available in the future. These are also to be supplemented by all-weather road construction, particularly in the vast hinterland. Such schemes may well be looked at in the light of Australia's transport problems in the interior, where there are great distances and few people but important pastoral industries.

## Industry

Much of what you have read points to the fact that with progress in transport facilities and a greater exploitation of sources of power, Brazil should make important industrial advances. As we have seen already, the largest industrial region in the whole of South America is in the Sao Paulo-Rio de Janeiro region and there are growing centres elsewhere as at Porto Alegre.

## Population

**1. Density distribution.** The distribution shown on Figure 53(b) is obviously closely linked with the physical resources discussed above. The first feature we might note is that in terms of its huge size Brazil is relatively thinly populated by 58 million people; there are vast areas uninhabited or carrying very few people at all. While some of these regions may never carry many people because of sheer physical obstacles, as in the Amazon selvas, there are other parts with great possibilities. These could easily help to absorb the present increase of one million people per year for many years to come.

Apart from population sparsity, the map illustrates clearly how at present the population is very unevenly distributed. Thus we can note the density of the eastern coastlands and the immediate hinterland as contrasted with the increasingly thin spread to the west. In fact, it has been calculated that almost 90 per cent of the population is in the eastern third of the country. These inequalities can be explained largely in the light of what we have discussed already concerning the contrasting character of landforms, climates and soils and the availability of foodstuffs and raw materials, together with types and efficiency of transport.

There is a predominance of large cities as ports on the coast or as markets and service centres for agriculture and mining regions on the nearby uplands. This marginal occupance by urban districts shows well marked groupings in the south-east and north-east, while more isolated "spot" settlements appear towards the interior, on the equatorial coast of the north and along the Amazon. Most of these are magnificent in their layout and appearance and owe their origin to certain special circumstances. Thus Manaus represent early fabulous wealth from the jungle

and an attempt to retain Latin culture far from its homeland; Salvador has the earliest of historical links with Portuguese colonisation; Rio de Janeiro is the possessor of possibly the most beautiful harbour in the world; Porto Alegre is a tribute to the skill and determination of Brazil's most recent immigrants; and Belo Horizonte is the specially planned capital of Minas Gerais, containing an array of outstanding modern buildings.

**2. Racial mixtures.** Much of the rapidly increasing population is still crowding into the cities to work in factories, which are more numerous in Brazil than in any other Republic. This will accentuate still more the contrast between the density of peoples on the margins and the thinness of the spread in the interior. The rapid development of urban numbers has produced great contrasts within the cities themselves: luxurious and modern buildings for a wealthy society on the one hand, and poverty-ridden slums on the other. This represents in part what we saw earlier concerning the persistence of the colonial aristocracy into modern times along with a large class living on low wages and at a low standard. So bad are conditions with some of the labouring class that millions suffer from malnutrition and disease, and there is a high infant mortality and a prevalence of malaria in many parts. All these social situations are scattered throughout the rural areas too, more especially in such places as the north-east, where there is a majority of Negro and Mulatto workers. Here plantations are in the hands of a few families, who control the production of sugar and cotton. With the decline of the sugar industry the segregation and contrasts are not so marked between owners and tenant farmers. From here, too, there is constant draining of workers to the urban regions.

One of the most remarkable features of Brazil's population is the racial mix-up, which is extremely complex. In our study of the general population spread and colonial settlement (Figures 46 and 47) we saw how the Portuguese had influenced these patterns. In particular it was noted that Negroes had been introduced as slaves to work the first plantations, and how subsequently there was much migration from Europe. Today the resultant mixtures are shown by the fact that approximately 64 per cent of the people are white, 15 per cent black, and the rest made up of Indians, Mestizos and Mulattos. The proportion of the whites is said to rise on account of three factors: immigration is practically confined to the white races, the coloured death rate is higher than the white, and the lighter-skinned individuals of mixed blood tend to pass into the white category.

The European migrants are of significance, since although they are but relatively recent arrivals, many of them have contributed quite a deal to the development of agriculture and industry in Brazil. They were attracted in the first instance to the south and south-east, where the temperate climate was more suitable to them and where the economic development seemed to offer the best prospects. The Italian has been the

next largest group to the Portuguese, and settling mainly in the State of Sao Paulo, they have done much by their vitality and good business ability to build up that region. Lebanese and Syrians are prominent in the commercial life of the country and are found scattered throughout it, more particularly in cities. Many people from Spain have also settled in various parts of Brazil, but large numbers of Germans are concentrated in the agricultural south-east. Slavs are also prominent, the largest number being Polish farmers in Parana. The most exceptional immigrants are the Japanese, who are to be found mainly in the State of Sao Paulo.

Notwithstanding the extraordinary racial melting-pot which has developed in Brazil, the process of mixing has been achieved successfully, so that racial equality is not just a theory but an established fact. Although there are certain evidences of social segregation, as in the case of the poorer and illiterate groups like the Negroes, all people are equal before the law, which can even punish for racial discrimination.

At the present time the stationary numbers of the black peoples and the growing numbers of whites, together with intermarriage, is said to be leading to a gradual disappearance of the dark peoples. European migrants are also being rapidly assimilated into the cultural and social life of the country, which is still and will continue to be strongly Portuguese. This, too, is of special significance because it has eliminated the problem of racial minorities.

Altogether, the country of Brazil is fairly uniform in its population, a factor which is striking when we consider its size, the variety of its regions and the history of its peoples. Such aspects might well be contrasted with the situations which have arisen in Africa, and to which reference has been made at length in the chapters devoted to that continent.

## EXERCISES

1. Compare generally the environment and development of eastern Brazil south of the Equator with that of East Africa between 5° N. and 25° S. latitudes.

2. Discuss the geographical reasons for the development of the highlands and coastal plains of eastern Brazil, and explain why this tropical area is so densely populated.

3. What are the main difficulties affecting transport in Brazil? How are they being solved and what important developments may be expected in the future?

4. Draw a map dividing Brazil into five or six main geographical regions. Write short notes on the main features of each region shown on your map.

5. Draw a detailed transect diagram across Brazil from Porto Alegre to Fortaleza. Use Figures 51 or 56 as a guide to the amount of detail required.

# CHAPTER XVIII

# CHILE

We have already seen something of the general geography of Chile in our previous studies of the landforms, climate and vegetation of South America as a whole. It remains for us to form a clearer idea of Chile as a country and in this we are helped considerably by the series of map-summaries set out in Figure 54.

In the first place it enables us to appreciate the extraordinary shape and size of the country, which is unlike any of the other Andean republics in nearly every way. It is a narrow ribbon of land, never exceeding 100 miles in width but stretching a distance of more than 2650 miles, which is over half the west coast of the continent. With its area of some 286,000 square miles, extending from tropical to high latitudes, it has a wide range of climate types and physical and cultural landscapes. In order to give some organisation to our studies of these it is proposed to divide Chile into three major geographical regions.

## Desert Region of Northern Chile

Physically this consists of coastal ranges which rise sheer from the ocean to 3000 feet above it. They continue like this for some 600 miles and so there are no harbours or anchorages. East of this range is a number of dry basins or bolsons lying on a plateau of about 2000 feet in elevation. These bolsons may be up to 50 miles wide and represent old lake floors. As the ancient lakes evaporated with the increasing aridity of the climate, the salts in their waters were deposited. One of the layers is the valuable "caliche" (nitrate-bearing gravel) with an average depth of a foot or so and containing sodium nitrate, sodium chloride, iodine salts and other materials. These would have been washed away long ago in a rainy climate.

Towards the foot of the cordillera is a series of large alluvial fans from Andean river valleys. The general landscape is monotonous, since this Atacama Desert is one of the most arid places in the world. In it there is no rain for years, no surface streams except one, and no plant life. Seepage water in the alluvial fans cannot be reached normally because it is too deep. As a result the natural inhabitants of the interior are peasant Indian farmers living in oases at the entrance to the mountain valleys, where some vegetation and crops are possible.

Nevertheless northern Chile is of great economical importance because of its minerals and salts. Chief among the former is copper ore, the largest deposits in the world being located in the mountain lands behind Antofagasta and near Coquimbo, Copiapo and La Serena. Some of these towns

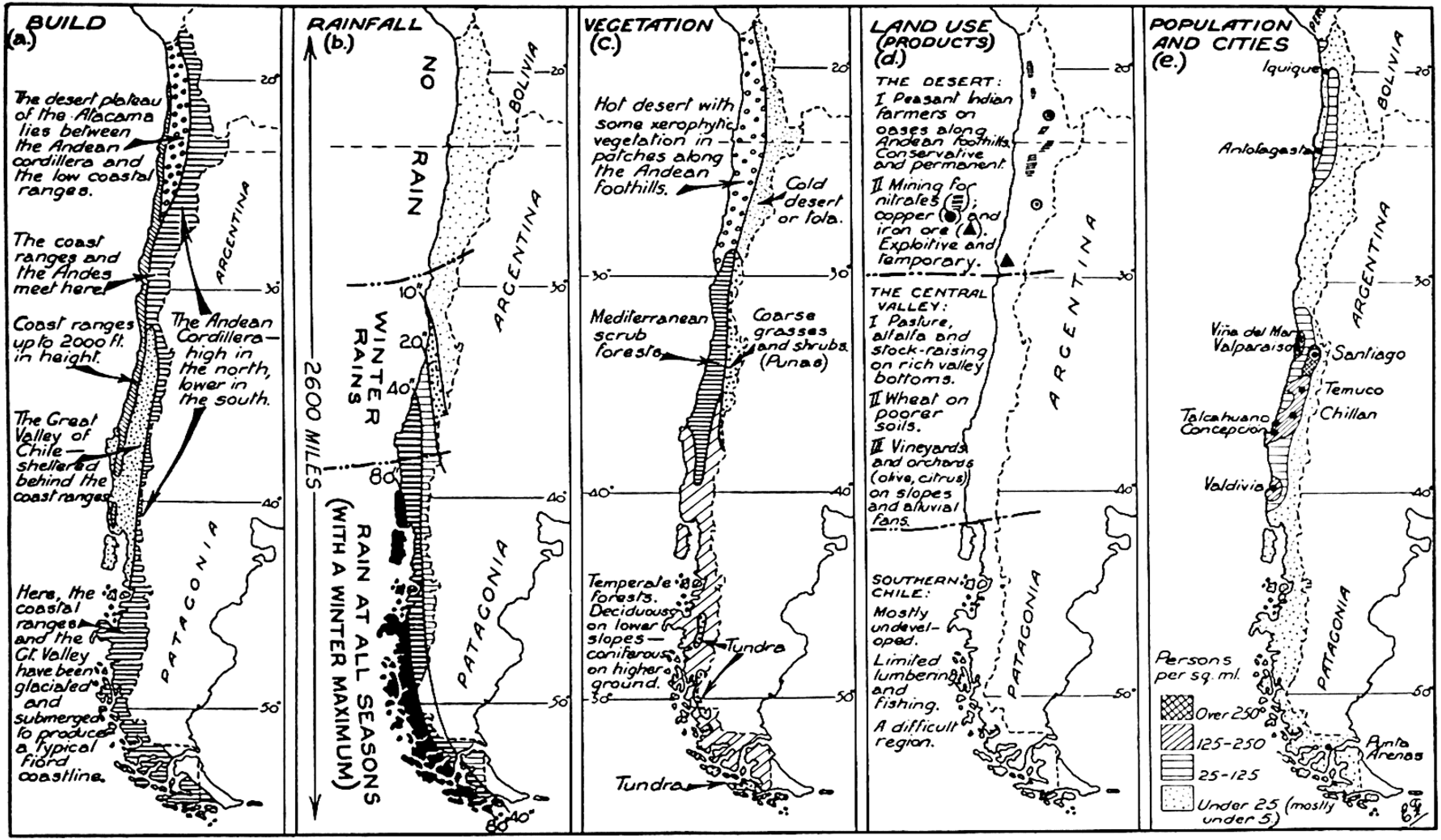


FIG. 54. *Map-summaries of the main features of Chilean geography.*

also mine iron ore, which is exported to the eastern United States. Nitrates are also very important exports. These are obtained by blasting the caliche rock from the "salares" (salt basins) and treating them in "oficinas" (nitrate works). Two of the largest of these plants are now situated inland from Tocopilla. Water, which is so important in dissolving and crystallising the salts, is obtained by pipeline from wells at the foot of the Andes and the Coast Range. An important by-product is iodine, Chile being the world's greatest producer of this chemical. Nitrates are exported mainly to the United States for use as fertilisers and for the manufacture of nitric acid. The main problem has been to meet the competition overseas of nitrates made from the nitrogen of the atmosphere, but in any case it is a matter of time as to how long the Chilean deposits will really last.

Population is relatively small and cities few. These are mainly "ports", literally clinging to the coastline. Lighters have to convey exports to vessels standing off-shore. Important towns, other than those already mentioned, are Iquique and Arica. Arica has considerable trade with Bolivia, is joined by rail to La Paz and exports tin. Antofagasta is also connected by railway to Bolivia, Argentina, and Santiago to the south.

### Mediterranean Region of the Central Valley

This great valley is over 600 miles long and 20 to 30 miles wide. It lies between a broken coast range which rises steeply from the sea to some 6000 feet and the Andean Cordillera. Streams from these mountains have laid down deep sediments as alluvial fans in a manner similar to the valley of California. They then continued to cut deep gorges through the coastal uplands to the Pacific. These rivers are of little use for navigation, being usually swift-flowing in winter and shallow in summer. Despite the fact that there are no large longitudinal streams like the Sacramento and San Joaquin the drainage system has made possible the extensive use of river water for agriculture and aided the construction of new systems of irrigation, canals and dams, especially in the Aconcagua Valley. With the completion of new schemes, it is calculated that the irrigated areas of Chile should reach well over four million acres.

With a gradual change from the desert conditions of the north, the climate of central Chile is said to be one of the most delightful in the world. Although its general character is described as Mediterranean, it has cooler summers than either California or the Mediterranean lands themselves. Rainfall, with a winter maximum, increases from north to south, so that the climate in the higher latitudes approaches the west coast humid type. Vegetation is typically evergreen scrub and forest, giving way to grasses and punas as the mountain slopes are ascended.

The major crops are the grains, especially wheat (the most important cereal), maize (the chief peasant foodstuff), rice, rye, oats and barley. There is a considerable export of the last two. Many varieties of citrus

and deciduous fruits, nuts and grapes are grown, largely for local consumption. It is worth noting that the wine industry is one of the oldest and most important in the country and mainly meets the home demand. In contrast with California and other Mediterranean-type lands, commercial orchards are actually few in Chile. Beef and dairy cattle, as well as sheep, are pastured on valley floors in the winter months and driven to the mountain pastures in summer, where there is still enough rain for the grasses. The alpacas and llamas, used in the upland districts for transport, provide a valuable source of wool. In general, stock numbers are not great and meat has to be imported from Argentina.

The system of land tenure is of special interest, since haciendas (large estates), many of over 10,000 acres, still persist from the early period of colonisation. As a result landowners live in considerable luxury either on their properties or in Santiago. On the other hand, the agricultural labourers or peasants dwell mostly in the traditional mud brick or adobe houses. Legal measures and advances in social legislation are leading to the subdivision of estates and the provision of better amenities for workers.

Agricultural progress is being made in methods of farming and transport, with the introduction of more tractors and the extension of electric railways. Areas are still retarded by bad roads and lack of man-power. Typical of this situation is that the ox-cart is still the principal means of road transport.

Copper (the Braden mine near Santiago), coal (near Concepcion), and iron ore mining are carried on in central Chile. As a result industries, helped as well by cheap electric power from mountain rivers, have been able to develop more than in most South American republics.

The increasing number of industries has developed in the towns, even though most of these are the agricultural and distributive centres for the central valley. Santiago, the capital of Chile, has a population of over one and a half million, and is the chief industrial centre, specialising in textiles and food processing. Whilst this city is situated in the central valley more than 100 miles from the coast, Valparaiso is Chile's chief port, with a population of 400,000. Unlike most Chilean ports, it has a deep sheltered bay with piers and docks for handling large ocean liners. It is also the western terminus of the Trans-Andine Railway, which reaches across Argentina, and it makes rolling stock for this line and the 6000 miles of railway throughout central Chile. Other manufactures include sugar refining and lumber. Its main defect is that it is liable to suffer from earthquakes, which are common throughout this particular region, since the Coast Range and the valley floor, which slopes gradually to the north, are still rising. Concepcion on the Bio Bio River (which is the southern boundary of the valley) and Valdivia are the main markets and ports for the southern region. Altogether with these cities and a dense rural population, the central valley is the most densely peopled area of Chile.

### Southern or Forest Chile

The northern section of this region is similar in structure to the area just described except that the mountains are lower in elevation and the central valley less well defined. Glacial lakes take up large areas, and volcanoes are found on its fringes. In the southern two-thirds the valley disappears into the sea, the Coast Range becomes an archipelago, and the mountains, now greatly glaciated, produce a typical fiord coast of islands, channels, peninsulas and big narrow inlets. The whole is similar in character to that of southern Alaska. Climatically it is cool and wet, the rainfall and general cloudiness increasing in the higher latitudes. Up to 200 inches of rain per year have been recorded in the far south, where many glaciers come down from the Andes. Where the land is not rugged and rock-bound, a heavy covering of forest has resulted, with temperate and deciduous types on lower levels and conifers appearing at higher elevations. In certain sections the height and climatic circumstances have even produced tundra vegetation.

In the north much of the forest has been cleared to be replaced by small farms producing such cereals as wheat, barley, rye and oats, as well as deciduous fruits and potatoes. Stock rearing and dairy farming are other agricultural pursuits. Lumbering and coal and iron mining (near Valdivia) are major secondary industries.

More recent developments in the Chilean economy include steel manufacturing at Huachipata and Valdivia to which are allied subsidiary activities concerned with the production of tin plate, steel pipes, wire, agricultural and industrial machinery. The textile industries make linen, woollen and cotton materials. Much of this occurs in the cities of Santiago, Valparaiso and Concepcion, but other important centres are Puerto Montt and Temuco. Much future progress can be anticipated in the southern portion when a scheme to harness the extensive water resources into a great national electricity undertaking is realised. An important tourist industry is expanding with visitors from the United States and from other South American States.

To the above three regions one might add a fourth, sometimes referred to as "Atlantic Chile". Apart from island groups like the Juan Fernandez, this mainly includes the Punta Arenas lands. Here there is an important sheep industry from some three million animals. Most of the inhabitants are concerned with this industry in all its phases, from breeding and growth to the preparation and export of wool, skins and meat to the United Kingdom. Coal is available for local needs and the discovery of petroleum in Tierra del Fuego and the establishment of a refining plant near Punta Arenas have meant much to the wealth of the region.

# CHAPTER XIX

# ARGENTINA

Argentina is the second largest country in South America, being one-third the size of Brazil in area and stretching from the Tropic to latitude 55° S. and from the Atlantic coast to the crest of the Andes. Within its million square miles are several regions varying in physical features, land use, economic development and distribution of population. In general, Argentina shows several important differences from other countries in South America. In the first place the bulk of it lies within temperate zones with considerable areas of flat and fertile land. This has encouraged its settlement and development by Europeans and their descendants, so that today it is white man's country with a fraction of the population made up of native Indians, Mestizos, Mulattos and Negroes. A large percentage of the people have Spanish and Italian ancestry going back to colonial times, while considerable numbers of immigrants from Europe have settled there in recent years. Then again, almost one-third of the people live in cities in spite of its essentially agricultural economy; it has a big export of primary products. Also it is lacking in ores and sources of power but has managed to build up some manufacturing industries. It is the most progressive and virile of all the South American Republics in spite of internal problems such as those based on land tenure and external problems relating to trade.

For purposes of our discussion we shall divide Argentina into a number of regions. Reference to Figure 55 will give a general idea of how the boundaries separating each of these regions can be defined by certain differences in human activities. These vary with the major physical conditions of topography, soils, accessibility and so on.

## The Arid North-West

This region lies along the eastern foot of the Andes for nearly 1500 miles. It consists mainly of spurs from high ranges with valleys between. There is also a series of north-south foothills enclosing broad basins or oases. In one case a long trough lies between the foothills and the Cordoba uplands. Much of the soil is sandy, with considerable gravel, but there are fertile alluvial fans where streams come from mountain valleys. Mendoza is situated on one of these. The outstanding characteristic is the aridity. Except in the north round Tucuman, where the rainfall is about 30 inches, at least one-third of the region has less than 10 inches, and much of it falls in summer when evaporation is high. Droughts occur frequently.

Most of the rivers, which are snow-fed from the Andes, disappear

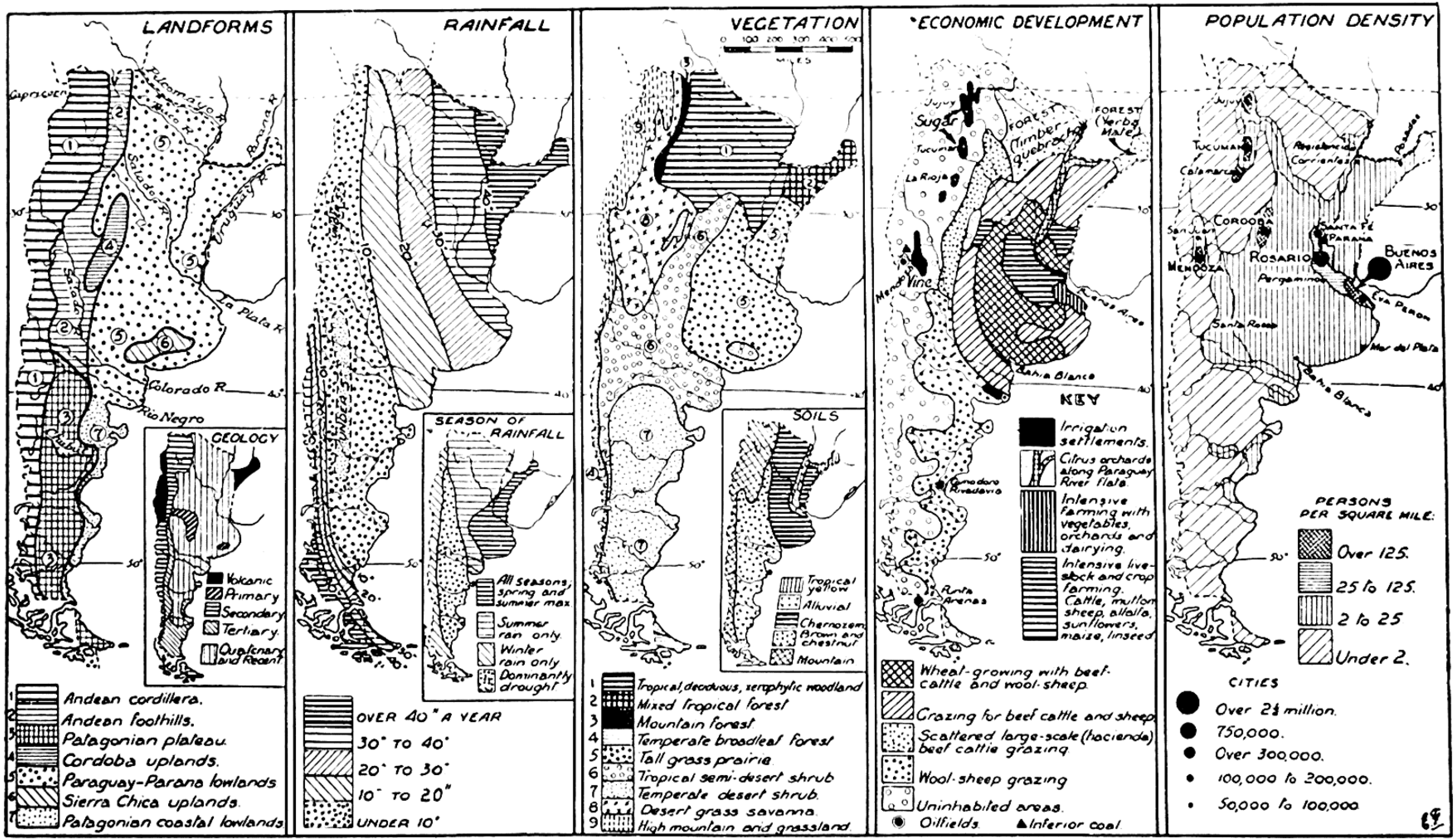


FIG. 55. *Maps summarising the geography of Argentina.*

into the plains, and only a few are permanent. The natural vegetation reflects these conditions and consists largely of coarse desert grasses and plants with thorny scrub. There are some woodlands along the permanent streams and these are valuable for building and fuel. Much of the land is uninhabited, with salt flats and salt lakes, e.g., between Tucuman and Cordoba there is one region of 7000 square miles which has no people at all, but in some parts sparse grazing is possible and specialised crops are grown by irrigation. The pastoral industry goes back several centuries to the time when Spanish mines in Peru and Bolivia needed fresh food and beasts of burden. There was always a close connexion with the mining settlements of the mountains and the Pacific ports through which minerals

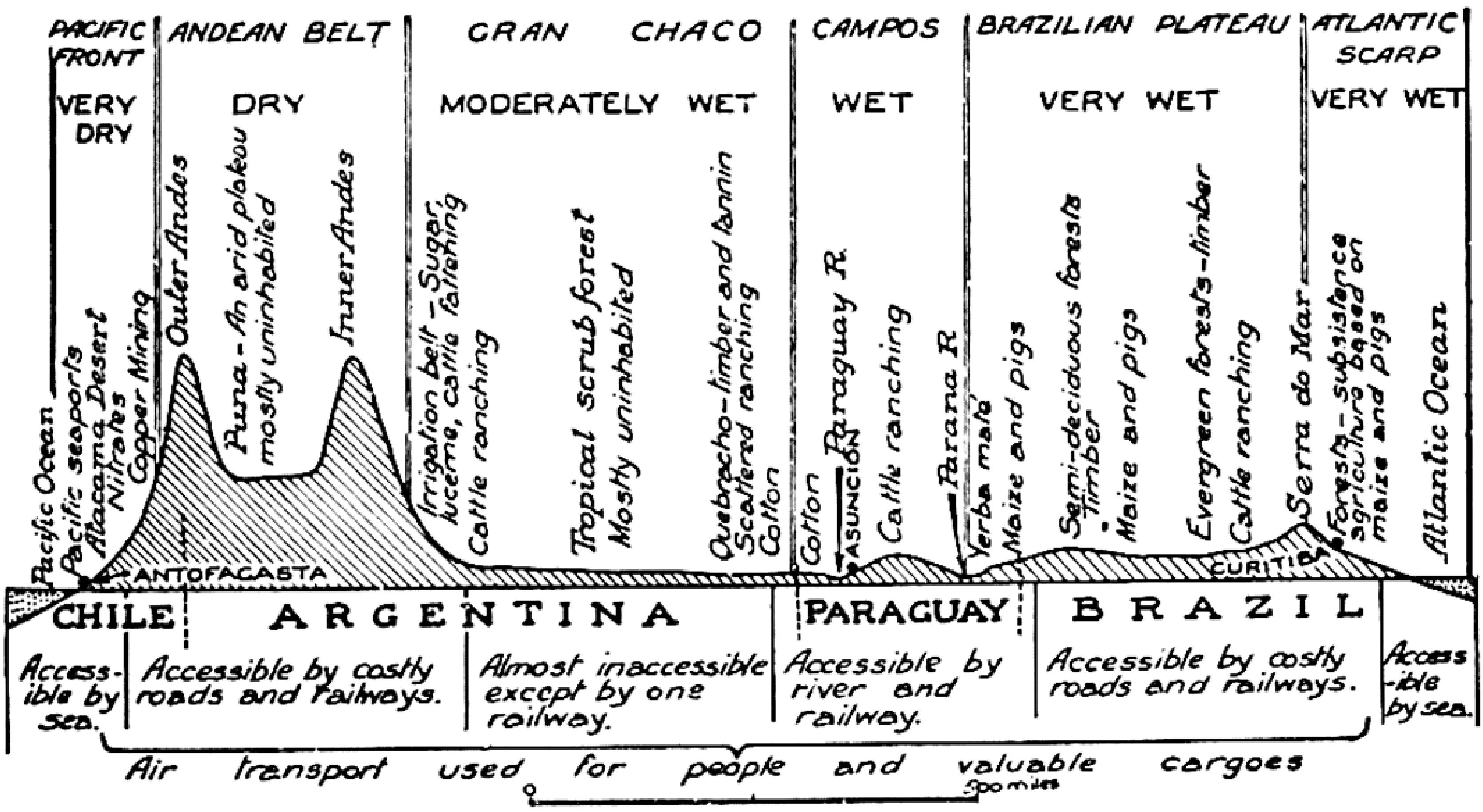


FIG. 56. *Transect across South America at approximately 25° S. latitude.*

were sent via Panama to Spain. Tucuman was thus an important trading post, especially in its later links with the settlements of Asuncion and Buenos Aires to the east. The main item of trade was the mules, which, bred by the semi-nomadic gauchos or cowboys on the grasslands, were later used for the portage of goods and minerals on the high mountain trails. Food, water, horses and wagons would also be traded here. Today the livestock industry is not so important, although there are large estates in the upland valleys that practise transhumance to the mountain pastures. They produce low-grade beef for eastern markets and, with crops of irrigated alfalfa and maize, fatten stock for local sale. Merino sheep and goats manage to graze on the poorer lands; about Cordoba a large proportion of the goats of Argentina are raised for their skins. Further expansion here is doubtful in view of the distance from markets, the cost of transport and the isolated nature of the small holdings. As Figures 55 and 56 show, the irrigated lands are scattered along the pied-

mont of the Andes, with two major settlements in oases about Tucuman and Mendoza.

As we have seen already Tucuman was an important trading centre in colonial times. It was joined by a railway line to Cordoba in 1874, and it has changed its character to become a region of intense agriculture devoted mainly to sugar-cane. This crop now occupies over 60 per cent of the farmland round Tucuman and produces four-fifths of the supplies of the Argentina. As a result, it has one of the highest rural densities of population of Argentina. The main physical factors responsible for this are suitable temperatures and absence from frosts—they occur east and south—and a rainfall of 37 inches. Since droughts are liable to occur, irrigation is practised with water from the mountain streams. There are both private and government schemes. Mills and refineries are to be found about Tucuman itself and raw sugar is also sent to Rosario and Buenos Aires. There is also production of grapes for wine. The labourers who work permanently or seasonally on the large plantations come mostly from northern Argentina. Some rent their own small farms and as there are few foreign recruits the population has a distinctive character. Jujuy, to the north, also produces sugar, but concentrates more on maize.

Mendoza is the most important of the regions which lie to the south. Here the climatic conditions and drainage are such that irrigation is absolutely essential. The rainfall in particular diminishes rapidly, giving way to the wide arid lands which merge into the cool desert of Patagonia. Thus the annual rainfall at San Juan is only about three inches and at Mendoza is about eight inches. These small amounts are supplemented by the larger mountain streams flowing through alluvial fans. These two areas are therefore oases in the fullest sense. Others are La Rioja and Catamarco. All these grow alfalfa and grapes, together with corn, vegetables and much fruit. The largest acreage of land is devoted to alfalfa, on which beef cattle are raised for the upland oases, and for local urban needs. The vineyards are found mostly around Mendoza, and most grapes are converted to wine, since it stores and transports well to distant markets in Buenos Aires. This particular wine is in demand by the labouring peoples of that city. Those most interested in this industry are mainly Spanish and Italian migrants who have a special background in this type of agriculture, e.g., the type of grape to be grown, suitable soils, location, and technique. The bodegas, or people who actually make the wine, specify all this before finally buying from the owners of the vineyards. The bodegas own the larger vineyards, but the bulk of the small properties are individual holdings.

Mendoza is a famous pass city, having long associations with early Spanish settlements in Chile. It was the stopping place for travellers going over the Andes via the Uspallata Pass (12,000 feet) to central Chile and Valparaiso. Modern Mendoza is a fine city, with some relics of former Spanish buildings, although many of them have been destroyed by earthquakes. There is considerable manufacturing devoted to the process-

ing of grains and foodstuffs and the making up of agricultural materials. It will be noted on the map that there is some mining activity near Mendoza. The coal is of poor quality, but the oilfield is believed to have great possibilities.

### The North-East

This north-eastern corner of Argentina is sometimes referred to as "Mesopotamia" and is a long tongue of land of about 74,000 square miles lying between the Parana and Uruguay rivers. In the south the land is low plain and liable to floods by the Parana, which is poor for navigation because of its frequent changes of course. Towards the north the landscape changes to hilly country with swampy valleys. Eventually, in the extreme north-east near the southern extension of the Brazilian highlands, it gives way to flat-topped plateau land. This is rugged land due to the erosion of deep valleys by the Parana and its tributaries. One of these has a spectacular drop over the plateau edge to form the famous Iguassu Falls. At present they are useless for the generation of power because there are no urban areas near by, and those of any importance are too far away for the effective use of power lines. This country is often called "Misiones" because of its early associations with the Jesuit missionaries who first colonised it successfully. Climatically it is hot, wet and humid, with rainfall increasing towards the lower latitudes of the north. Here it is between 40 and 60 inches, most of it occurring in summer; the winters are relatively dry and cool. These conditions produce grasslands in the south and mixed tropical forest in the north. Both types of vegetation are closely associated with economic development. Thus, although the mixed forests of pine are as yet only partially exploited, the yerba mate tree produces leaves from which Paraguayan tea is made. It is now grown commercially in plantations around Posados to supply a South American market almost exclusively. This is a revival of an industry which was established among the natives in early times by the Jesuit missionaries. Today the Indians still work on the plantations. They also do some subsistence farming of their own, mainly along the Brazilian border. As reference to the map will show, the pastoral and agricultural pattern towards the south becomes more important. Beef cattle are raised over much of the grasslands on large estates, which centre on Corrientes. But they suffer from the disadvantages of pests, poor breeding, poor quality meat and marketing difficulties. This makes competition difficult against other cattle-raising parts of Argentina. Wool sheep thrive so well in the drier south-east bordering Uruguay that this area has become a leading sheep district, with considerable overseas exports. Wheat and flax are grown in increasing amounts here, largely by the farming methods of German and Russian immigrants. Linseed (the seed from flax) is an important export of Argentina, although in recent years it has been surpassed by sunflower seed. There is a wide variety of uses for both of the oils, mainly

for paints, margarine, soaps and the making of linoleum. The residues can be used as stock feed.

The cultivation of excellent oranges along the Parana River flats has always been easy because of the ideal conditions. But high transport costs, shipping delays and bad management affected the industry for years, so that only local markets were reached. With improvement in these matters a small export trade has developed together with a concentration on the extraction of the oils from the leaves for chemical purposes.

### The Gran Chaco

This region gained its name because it was formerly an area where the Indian tribes sought various kinds of game for food, hence the "Great Hunting Ground". It is situated between the Paraguay River and the north-western region described earlier and extends into Paraguay. It consists of about 150,000 square miles of lowland plain built up by alluvium brought down from the Andes over millions of years. Periodically the rivers, including the Pilcamayo and Salado, become flooded and cover wide areas leaving them often with swamps. As it is near the Tropic there are very high temperatures in summer, when most of the rain falls, so that there is high humidity and evaporation. These conditions favour the breeding of many pests and diseases. The rain decreases towards the west and winters are so dry that water is actually hard to find in that season.

Much of the country is covered with thick scrub forest and savanna and some parts are difficult to penetrate. In the thicker forests of the central west and north-east are found the famous "quebracho" or "axe-breaker" trees. The type in the north is used for the extraction of tannin, which is needed in the leather trade, while the other goes to the timber mills for such uses as posts, sleepers and so on. Some is used for charcoal. The location of suitable cutting areas is determined by the availability of transport, and relation to mills and processing plants, e.g., rivers supply the water needed in tannin extraction. It was the woodcutters who first penetrated much of the country from Resistencia in the middle of the nineteenth century. Otherwise much of it was most uninviting to pastoralists and farmers. There has been some cattle raising in the better parts of the Gran Chaco for hundreds of years, but it is still only a minor industry in the hands of a few private owners of haciendas. The main problems of development are those similar to the llanos, i.e., seasonal lack of water and good grasses, diseases and pests, remoteness from markets, and difficulties of transport.

Arable agriculture has always been limited by the physical conditions here, but for many years farmers have managed a sporadic cultivation of crops like maize and wheat along the flood plains of streams such as the Salado.

In recent years there has been a spectacular attempt by the Government to establish cotton plantations along special north-western railways

with Resistencia as the centre. Many central European colonists were encouraged by finance, cheap land, homes, free seed and so on. Despite this and despite the help of agricultural advisers, complete success is not yet assured and only some farms have done well. It has now become the chief cotton-producing centre of the Republic, with some export. Indians help with the harvest, but the owners often lack farming experience and have great difficulty in coping with the periodic destruction of their crops by such pests as the locust.

### Patagonia

Patagonia is the long extension of Argentina south of the Rio Colorado and lying between the Andes and the sea. Although its area is about 300,000 square miles, which is more than a quarter of the country, its environment is generally so unattractive that the population is almost as sparse as on the Amazon selvas.

In structure it is an irregular plateau which rises from cliffed coasts where there are few openings suitable for harbours. The general level surface is elevated westward in a series of great scarps, finally reaching a height of 5000 feet near the foot of the Andes. Here there is a long north-south depression separating the plateau uplands from the mountains. Many beautiful lakes formed by glacial action in the past occupy this low belt. Together with the forested slopes and valleys of the towering cordilleras, they provide some of the finest scenery in the whole of South America. Some areas of the surface are gravel, shingle or bare rock; others have soil and rock materials deposited by rivers and glaciers. Neither surface nor ground water can be located over most of the plateau and there are only a few rivers flowing into the Atlantic, e.g., the Colorado, Negro and Chubut. These have cut deep into the plateau to form large trench-like valleys. It is only in these canyons that the people can live, because of their water supply, the shelter they give from the strong cold winds and the safe routes they provide across sections of the plateau.

The climate is cold and dry, for little rain falls at any time, under 10 inches mostly (see Figure 56) and droughts are possible. One cause for this desert character is the western mountains which act as a barrier to the belt of wet windstreams flowing from the Pacific side. The other is the cold off-shore current in the eastern waters.

No trees can exist in the areas exposed to the constant powerful winds and only short coarse grasses develop from winter snows.

Effective settlement here by colonists did not really start until late in the last century after the hostile native Indians were wiped out. Men of several nationalities entered the country, the British and Scottish (some being sheepmen from the Falkland Islands) as well as Spanish working the sheep runs, and the Welsh and Germans doing agriculture mainly in the valley oases. An interesting group was the Welsh colonists, who settled in the Chubut Valley in 1865. Their descendants, who have fruit and dairy farms, retain their national characteristics and language.

The raising of sheep for wool is the main occupation. Most of the properties are over 50 square miles in area, but are widely scattered and support only a handful of people. Exports of wool go by coastal steamers, operating from small ports to Buenos Aires in the north. The largest port in the south is Punta Arenas which is in Chile. Many sheep in the south are also raised for mutton. Altogether half the wool of Argentina is produced in Patagonia.

Cattle are not nearly so important and are found mainly in the river valleys where there are grasses, and in the western depression at the foot of the Andes. Sheep are also raised here as well as food crops and pastures. Actually the only croplands of any significance are found along the beds of several of the rivers, e.g., the Negro and Colorado. Simple irrigation grows wheat, rye and potatoes as well as alfalfa, which fattens stock before they are sent north to the humid Pampa. A modern irrigation scheme has been developed by the government along the Rio Negro. It supplies a narrow strip of some 60 miles along the river banks, and this is divided into 250-acre farms. Fodder crops are raised and vineyards and orchards cultivated for export. The pears from here command a very good market. Such intensive agriculture accounts for the higher density of population, as shown on the map in northern Patagonia.

The most important mineral production is that of petroleum at Comodoro Rivadavia. This field supplies a big part of Argentina's needs, some being refined on the spot. The resource is very significant economically to a country so singularly lacking in fuels and sources of power. Argentine railways are using increasing quantities of oil to meet their expanding programme of transport. Isolation and communications retard the exploitation of coal reserves and timber whilst tourist trade with the Andean scenic spots is almost impossible at the present time.

### The Pampa

La Pampa or "The Plain" is the name given to the huge area of flat grassy plain of Argentina which lies south of the Gran Chaco, east of the Andes and north of the plateau of Patagonia. It has a length of some 700 miles north and south and is 400 miles wide at its greatest width. Twice the size of the British Isles, it occupies nearly a quarter of Argentina.

In general the landscape appears flat, with little surface relief, but in fact there are certain variations in relief which will be mentioned later, since they have a distinct bearing on land utilisation and population spread. The plain is made up of a series of sediments laid down over ancient rocks. Such deposits came first from a shallow sea followed by river alluvials from the Andes and then volcanic ash and dust (loess) blown by such strong winds as the violent "pampero" from the southwest. Today these accumulations are said to be over 1000 feet thick in places, with a surface completely free of pebbles and stones. As Figure 55 shows, there is little soil variation, the greater part being rich chernozems.

There are few watercourses, and much of the drainage lies below the surface and has to be pumped by windmills. At the same time it is very valuable for growing the deep-rooted alfalfa. Where there are hollows the water collects and produces shallow lakes and marshes. The main river is the Parana, which is wide and has considerable volume; it is greatly increased by summer floods. These floods transport great quantities of silt into the Rio de La Plata estuary. As a result there is constant dredging in the shallow waters in order to maintain channels for navigation. Even the port of La Plata has to be treated in this way.

The average annual rainfall varies from 18 inches to over 30 inches; rain falls at all seasons with spring and summer maxima. The amount increases towards the north but falls off towards the south-west and the west, where there is the greatest unreliability. This possibility of drought is a significant factor in such highly developed agricultural lands and the term "humid pampa" has been used to distinguish that part of the plain which receives enough rainfall to escape frequent dry spells.

The summers are hot, particularly farther inland to the north-west, but cool off-shore currents make them milder to the south-east. Winters are so mild as to allow farmers to do outside work all the year round and to do without shelters for stock. The main hazard in this season is the frosts, which increase in severity to the south.

The natural vegetation is the tall plumed pampas or prairie grass, relieved only by an occasional tree. Much of it has been replaced by the planting of alfalfa, while large clumps of trees are usually planted about the homestead of the larger estancias. Coarser grasses and thorny shrubs appear in the lower rainfall area of the south and west, but higher precipitation to the north gives a heavier tree growth there.

The original inhabitants of these wide grasslands were nomadic Indian tribes who hunted on foot the rhea, a bird like an ostrich, and the guanaco, which is similar to the llama. Their main hunting weapon was the "bolas", consisting of three plaited thongs fastened to a common centre and weighted at the ends with large pebbles. When thrown properly it brought down the quarry by entangling the legs. It is of special interest because with the introduction of the horse, unknown to the Indians, it was adopted later by the "gaucho" or Argentine cowboy, who played so important a part in building up the pastoral industry of the country.

Following their discovery of the estuary in 1516, the Spaniards settled in 1536 at Ascuncion on the Paraguay River. At this time they were not interested in colonisation for the purposes of producing and trading in foodstuffs. They wanted to establish links with the oasis settlements in the western region and the mining centres of the Andes. Buenos Aires was established to give ships provisions and water after their transatlantic trips and before they sailed upstream to Ascuncion. It also became a fort to guard their interests against possible attacks from the Portuguese. Gradually great estates or estancias were established on the flat plains and European grasses were sown for the cattle. The first properties were

unfenced and the imported cattle as they bred roamed at will. They were supervised by the gauchos in the employ of the wealthy landowners or "estancieros". Beyond sending dried and salted beef abroad, together with hides, tallow and wool, there was no great interest in the meat trade, since there were no means of preserving meat.

This pattern of life continued for some 300 years until it was changed with almost dramatic suddenness in the mid-nineteenth century. There was then not only a big increase in world population but the rise of modern industrial development with an expansion of cities in Europe. This meant a big and increasing demand for foodstuffs and raw materials from new lands like Argentina in general and the Pampa in particular. The immediate effect was felt in the introduction of refrigerated ships which enabled Argentine beef to be shipped abroad in large quantities, especially to England. The meat was not popular at first, but with the development of freezing works and port facilities, the extension of the estates with proper fodder grasses and fencing to control breeding from imported stock, drilling equipment for water, and the building of new railway lines, the industry really boomed. Much overseas capital flowed into Argentina to help these many new improvements. Most of it came from England together with agricultural experts to direct operations. Along with the increased production of cattle, sheep (for wool and mutton), and pigs, was an extensive planting of grains, especially wheat and maize. All this called for more labour, and a flood of immigrants poured into the country. It is estimated that between 1860 and 1930 some six million Europeans, made up largely of Spanish and Italian peasantry, came to Argentina. Other nationalities included British, Germans, Austrians and later Poles. Associated with these were many seasonal workers, referred to colloquially as "swallows", who came from southern Europe to help with the harvests. All helped to bring about an important change in Pampa agriculture from pasture to cultivation; not only did they work as labourers, but many rented land from the big estates. Their main task was wheat growing to prepare the land for the alfalfa on which the owner later fattened his herds, but new crops were introduced in barley, oats and flax. The growth of cities also led to intensive growth about them in the form of market gardening, orcharding and dairying.

The Pampa is still primarily a cattle region, with much land devoted to pasture. But arable agriculture has invaded hundreds of thousands of acres of former grazing land, to be limited only by unfavourable conditions such as are found in the west. Today the distribution of all farming types is fairly clearly zoned in terms of climate, soil and other factors and it is to these that we now turn. You should note carefully the map of economic development as shown on Figure 55, since it will help you to see not only where the various human occupational activities are but their relative sizes and relation to population.

### Truck Farming, Orchards and Dairying

These types of farming are found near all urban areas throughout the Pampa. But the greatest concentration is shown on the map as being along the estuarine coastal strip and delta islands of the estuary from La Plata to north of Buenos Aires. Orcharding and truck farming here represent the most intensive of all Pampa agriculture. The farms are mostly of a few acres in size, but there are hundreds of them. Temperate fruits and vegetables of almost all kinds are cultivated in this area not only because of short transport and certain daily markets, but because of the excellent alluvial soils, good reliable rainfall and long growing season. Much of the orchard land is owned by fruit companies. Dairying is also favoured by the mild climate and the 40 inches of rainfall, which combined produce good cultivated pastures on swampy lands, while outdoor working conditions last the whole year. Farms vary in acreage and are usually rented as portions of large estancias. As well as from milk sales there is money to be made from the sale of calves for meat. Good fast transport to the cities and access to world markets through Buenos Aires has developed an export trade in dairy products.

### Intensive Livestock and Crop Farming

This crescent-shaped region north-west of Buenos Aires is regarded as one of the most productive agricultural regions in the world. It has the second highest density of population in the humid Pampa. Several general factors are responsible for this. There is a considerable area of alluvial soils near and west of the Parana, while the hot summers, mild winters and average rainfall of 30 to 40 inches provide the suitable climatic conditions for a number of kinds of agriculture. Then there is close contact with and short haulage to the urban area of Rosario. This is also a river port with facilities to enable direct exports overseas. Farther west there is also another area centred on Cordoba.

Over 40 per cent of the land is under pasture, on which the large landholders raise cattle and sheep. Many of the former are brought here for fattening after being bred on the special grazing lands of the south-east. They are then close to the freezing and chilling plants, which have direct access to docking facilities for refrigerated ships. This is also an advantage to the sheep industry, since mutton sheep are better adapted to the moister conditions of this region. Alfalfa is the main fodder plant here as in most other parts of the humid Pampa. It is valuable to both the pastoral and other agricultural interests because it has very good feeding value, can sustain dry spells and can last a long time because of its long roots. It is useful because of the manner in which it enriches the soils in which it grows. To get the best returns from plants and soils it is rotated over long periods with other crops, e.g., wheat and flax.

Maize is the most important crop in this region, literally forming a "Corn Belt" which embraces the districts of eastern Cordoba, southern

Santa Fe and north-western Buenos Aires. It is grown mainly by Italians as tenants of large estates or by owners of small properties of up to 200 acres. It is estimated that there are more small farms in this area than elsewhere in the humid Pampa. An interesting feature is that the harvesting is done by travelling corn pickers. The grain is not fed to local livestock as in North America. This is partly because there is not much demand for pig meats and partly because the type of maize has a small hard grain which transports well and is suitable for poultry and industrial purposes (glucose). Most of it is exported to Europe and is handled by the river port of Rosario. Flax is also grown in districts about this city and the southern part of Entre Rios, the district between the Parana and Paraguay. The seed is in big demand overseas because of its oils and to furnish linseed cake for European cattle. Sunflower seed has become a valuable crop in this region and is a strong rival for linseed as its oils have much the same uses. Margarine and soap making are two of its many possibilities.

### Wheat Growing, Beef Cattle and Wool Sheep

The "Wheat Crescent", as it is sometimes called, extends some 600 miles from Bahia Blanca in the south to about Santa Fe in the north. It is shown within these limits because of a number of factors; the main ones of which are climate and soils; rainfall lessens to the west and south-west, poor soils and drainage are unfavourable in the east, while winters are too dry and summers too wet in the north. The actual areas which are devoted to wheat growing vary within the crescent, the greatest percentage of land planted to it being about central Cordoba. As the map shows, there is really a crop and livestock association here. Ranching is predominant always, and in some parts the wheat-growing lands occupy as little as 10 per cent to 20 per cent of the estates. It is explained largely by the fact that wheat raising was initially developed as a means of getting people to grow alfalfa for the livestock. The grain farming is done by tenants, share farmers or small landholders. The last named are colonists of central and southern European origin, and in recent years they have grown most of the wheat in the north, especially around Santa Fe. These people also have some stock, including horses, which are still used despite increasing mechanisation. But in contrast with North America, they have the advantage of short efficient haulage by rail to ports. In general yields are not high under these conditions, and the yearly production fluctuates considerably under the influence of such physical factors as climate and pests, and such human factors as farming by poor, illiterate and homeless peasants. There is also a marked reaction to the rise and fall of world wheat prices, especially in relation to the tenant-farming system. Thus more land will be rented out if wheat prices are equal to meat prices, but when the former fall, much of the land reverts to original pasture. Much of this is, of course, watched carefully by managers of estates, who are frequently experienced agriculturalists

from the British Isles. On the whole there is usually a considerable export of wheat, subject, of course, to changes in quantities available.

Other crops produced in the wheat crescent are barley, rye and oats, the last two being used as fodder in the south near Bahia Blanca and the former supplying home breweries and distilleries as well as some livestock fodder demands. To the north corn and flax are possible. Wool sheep are found in the drier districts of the south-west bordering on the grazing lands for beef cattle and sheep.

## Grazing for Beef Cattle and Sheep

Reference to the map will show two zones, a smaller one to the east and a wide crescent-shaped zone to the west.

The former region is the land of the original great estates in colonial times. The eastern location provided all-year grazing: plenty of rain for pasture grasses on land which was low-lying while poor drainage and heavy soils prevented crop growing. Today it is the home of Shorthorn blood-stock imported in great numbers at great cost, mainly from the British Isles. Beasts are reared here and when two years old are sent to the alfalfa-wheat estancias for fattening. All this involves short transport because of proximity to meat plants and export ports. In addition, labour needs are small and cheap, there being few tenant farmers in this purely pastoral activity. This means a big reduction in costs in contrast with the North American lands. Sheep are mutton varieties, originally stock imported from the wet downs of England, and so adapted to the moist conditions of this region.

In the west are the crossbreds which give both wool and meat. There was a time when wool sheep were predominant in the eastern parts. This was because of the cheapness of larger areas of flat well-grassed land, suitable climate, small labour needs and good supervision by imported shepherds. In addition there were good wool markets in Europe, and wool carried well during the lengthy period needed to get it there. But with the later demand for beef and the introduction of intensive and extensive cropland, wool sheep were gradually forced to the west and south. As a result the drier areas of the Pampa and the uplands of Patagonia in particular became the wool regions.

As for cattle, Hereford stock was introduced to cope with the poorer pastures and rougher country. Today these form the bulk of the western stock. In the northern sub-tropical area the cattle are fewer because of adverse climate, more difficult transport and the hazards of ticks and other diseases.

## Manufacturing, Transport and Urban Development

Stock rearing and crop production are the mainstay of Argentina's economy, taking up over 50 per cent of the land use of the country and being responsible for the spread of the population as shown on the map

(Figure 55). This, too, is closely related to the transport pattern and the growth and function of the major cities. Mining is not significant, although there are quite a number of minerals, the most important being oil, coal and gold.

The waterways of the Parana and Paraguay are of great value to Argentina, especially in their lower courses and estuary, where there has been a development of ports. Constant dredging is needed to maintain good navigation channels and docking facilities. But it is the railways which have opened up the country. Although roads are easy to build on such a level surface, they are difficult to maintain, since road metal must be imported and wear means much dust and mud, particularly in the rural districts. In recent years there has been an extension of road building because of an increase in motor traffic and because the railways depend so much on imported fuel. Roads provide a very important function in bringing agricultural products to railheads and returning with manufactured goods. In the more populated rural areas no place is more than twelve miles from a railhead. There are four main lines which with branches make up a close fan-like network focussed mainly on Buenos Aires (see Figure 48). One southern line connects up the rail centres and ports of Bahia Blanca, Mar del Plata and La Plata. Then there is a line to the south-west which includes such important agricultural centres as Santa Rosa. The western line goes to Mendoza and the north-western to Rosario, Cordoba and Santa Fe. A trans-Andean line connects north-western Argentina to Antofagasta in Chile and so facilitates exchange of fertilisers for the irrigated foodstuffs of the piedmont oases. Altogether there are 26,000 miles of railways, including 200 miles of city underground.

Although the railways were built by foreign investments and included at that time all locomotives and rolling stock, they were recently taken over by the Argentina Government. Their main problem now, apart from fuel, is the difficulty of unification because of the variety of gauges in use.

The manufacturing industries of Argentina have undergone changes which in turn have been reflected in certain aspects of the social, economic and political life of the country. In the early commercial developments of the late nineteenth century there were great and expanding markets abroad for foodstuffs and raw materials. Great Britain was a valuable customer which in turn supplied bloodstock, many manufactured goods and fuels, like coal, in which Argentina was lacking. Domestic industries were almost wholly taken up with the processing of meats and grains. But two world wars and a depression between them seriously affected the idea of wholesale production and export of raw goods. As a result Argentina was faced with an increasing loss of overseas markets and a reduction of imports. Although there was some later improvement in the situation, a marked development of domestic industries had occurred in the meantime. The rise of these on a large scale led to many problems,

the more important of which were linked with the lack of fuel and power supplies and an increasing urbanisation.

The former is frustrating, since there are considerable raw materials to be processed in spite of the absence of certain basic ones. Low grade coal is in the far west and water power is negligible with almost no possibilities. Hence the concentration on petroleum resources, which are a national monopoly.

The growth of manufacturing and commerce has continued to place a disproportionate number of people of the Republic in cities, many of them coming from rural areas, where they were labourers or tenant farmers. All this has helped in the rapid rise and growing influence of a wealthy middle class and a large group of industrial workers. These are a distinct challenge to the social prestige and political influence of the traditional large landowners, even more so than in Chile. These landholders have always maintained a status based on the ownership of land and what it can offer in terms of good living, and not on money income. This of course relies on a large labour force of workers and tenant farmers, but there is evidence of a decrease in large estates and an increase in the number of small owner-worked farms. This is said to be due mainly to subdivision for inheritance purposes, mismanagement, and the sale of land by private companies. The whole process is taking place slowly and is strongly resisted.

There are many internal problems being created by a social situation in which there is a minority of wealthy landowners and industrialists and a majority of city labourers and landless farmers. The cities of the country have come to assume great importance and a brief study of the main ones will help us to understand why this is so.

## Cities

**1. Buenos Aires.** This great city is situated near the head of the estuary of the Plata and as we have seen played an important part in the early development of Argentina by the Spanish. At this particular site the river is over 30 miles wide and open to the cool breezes of the Atlantic some 150 miles away. Hence the name, meaning "good airs".

As the focus for the agricultural and industrial production of all Argentina, it has developed into a great port and with 3½ million people, is the largest city in the southern hemisphere. Actually it is not a good site for modern shipping, as the river is shallow and subject to silting at this point, but great sums have been spent in creating an artificial port with modern basin type docks, warehouses and grain elevators. These are all tied to an extensive railway network in the rural districts and manufacturers in the outskirts of the city. These are concerned with textiles, leather goods, glass, cement and paper. The import trade handles such articles as textiles, petroleum and machinery. Even with expansion and modern facilities the port has become congested and a new outport

has had to be built at La Plata. It has a good artificial harbour and is 30 miles closer to the sea. It is noted for its large freezing plants, which relieve much of the pressure on the meat industry at Buenos Aires. The capital has become a city of great wealth, with fine buildings, magnificent avenues and parks. It is also the cultural and educational centre of the State. Modern architecture is much in evidence amongst the older styles, and many new suburbs have arisen to house the increased population. Slums and poverty are also apparent, but schemes are being undertaken to do away with poor-class suburbs and substitute low rental homes.

2. **Rosario.** Rosario is on the Parana River some 200 miles upstream from Buenos Aires and ocean-going steamers of 10,000 tons reach there by difficult navigation channels. Port facilities are modern and efficient in order to handle the surrounding grain products, especially maize. It is regarded as the greatest corn-exporting centre in the world. Five railway lines help to make it the natural port for north-western Argentina. Manufactures include processing of sugar, meat and flour.

3. **Bahia Blanca.** This port is 250 miles south of Buenos Aires and has been developed to cope with the products of the southern part of the humid Pampa, especially wheat, wool and mutton. As a result it is a big railway terminal with a well-developed natural harbour on which are some of the world's largest freezing works. An interesting feature is its connexion with Rosario by a special railway line which taps many agricultural districts.

The main inland cities are very old settlements like Santa Fe, Cordoba and Mendoza. The first-named, nearly 400 miles up the Parana, has gained new strength with the increase in small farming by immigrants. Cordoba serves some of the best grazing land in the country, and handles livestock, hides and wool. Irrigation is becoming a special feature of its intensive farming. Mendoza, as we have seen already, is an irrigation centre which is going ahead with its production of fruits and wine.

It will be seen that, in general, the Pampa is not highly urbanised. It tends rather to a radial pattern of cities focussed on Buenos Aires. The map obviously cannot show many smaller centres which are typical of its rural districts in their form and function.

## EXERCISES

1. Vocabulary words and phrases: gaucho, transhumance, bodegas, yerba mâté, quebracho, pampero, chernozems, bolas.

2. Explain how the physical geography has caused marked contrasts among the occupational activities of the major sub-regions of Argentina.

3. Compare and contrast the environmental background and the occupational development of the Pampas of Argentina and New South Wales.

4. Discuss how the present transport pattern of Argentina has been affected by its economic development.

# SECTION III: NORTH AMERICA

## CHAPTER XX

## PHYSICAL FEATURES

### Position and Size

North America is a triangular land mass with its base in the Arctic and its apex in the tropics. It extends over 64 degrees of latitude, from 8°N. to 72°N. while the islands to the north of it reach to 83°N., or to within 500 miles of the North Pole. Its greatest latitudinal length is therefore about 4400 miles and its greatest width, through Canada and Alaska, is slightly less. Its position suggests comparison with Eurasia, which is twice its size and extends over greater latitudes. Both continents have the bulk of their areas outside the tropics—a fact which has a profound effect on their climates, vegetation and human occupations.

On Figure 57 North America and Australia have been drawn on the same map on an equal-area projection. The map shows the latitudinal position of North America and also compares it in size and latitude with Australia, which has been reversed to bring it into correct latitudinal and longitudinal position. This map should be referred to from time to time when dealing with climate and farming.

The total area of North America, including adjacent islands and Greenland (area 504,000 square miles), is over nine million square miles or slightly more than three times that of Australia. Of this an area of about 500,000 square miles only is inter-tropical, so that, unlike Africa, South America and Australia, the climate is mid-latitudinal (the so-called temperate climate), with all its variety and changeability.

The great latitudinal width necessitates five time zones in Canada and four in the United States. The five zones from east to west are, Atlantic, Eastern, Central, Mountain and Pacific, having as their central meridians 60° W., 75° W., 90° W., 105° W. and 120° W.

North America lies between the two greatest oceans—the Pacific and the Atlantic—and in the study of its geography it is necessary to take note of their effects on the land mass. We must notice the things that come from without as well as those that are developed within the continent.

In the North Pacific Ocean the American continent approaches sufficiently close to Asia to allow for a fairly easy passage from one land mass to the other—either directly across the 50-mile wide Bering Strait, or by the attenuated Aleutian Island chain. It was by way of this almost complete land route that the original settlers reached the Americas. Their subsequent movement and spread over the land is shown in Figures 47 and 98.

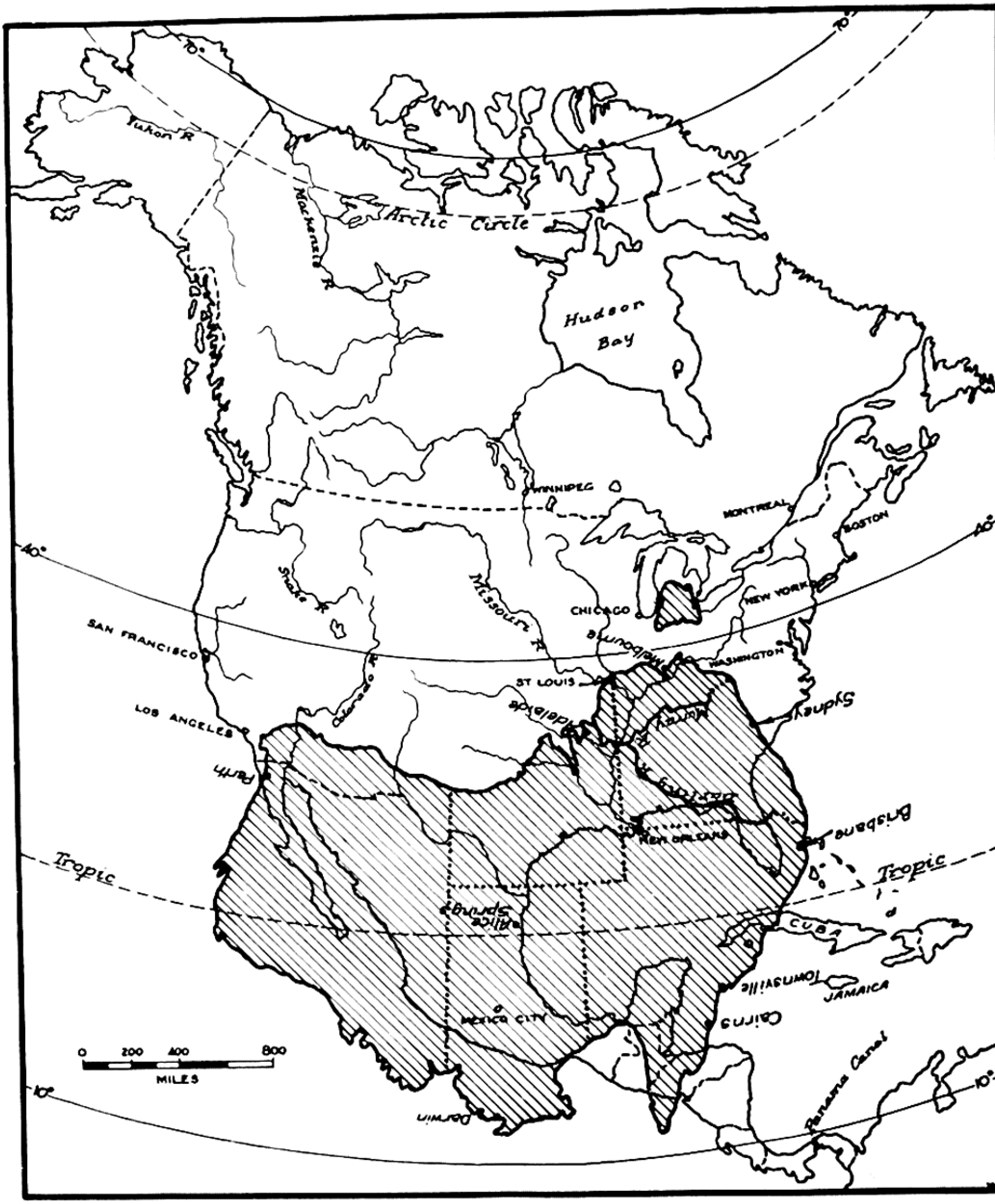


FIG. 57. *Position and size of North America compared with Australia.*

On the Atlantic side the ocean separated America from Europe until the tenth century A.D., when the hardy Norsemen "island-hopped" by way of The Faeroes, Iceland and Greenland to Labrador and Vinland (probably Nova Scotia or Maine). This contact was lost because of the hazards of the sub-Arctic crossing in open galleys. It was five hundred years before Europeans again made contact with the Americas, and then only after they had learned to use the north-east trade winds to carry them to the West Indian islands. Thus the settling of peoples in North America is related closely to its adjoining oceans.

In Chapter XXIV we will learn of the strong oceanic influences on the climates of the continent, with that of the Atlantic being the more significant because of the great bite taken out of the land in the Caribbean and Gulf of Mexico. This allows tropical oceanic influences to penetrate far into the interior of the continent. We shall see a similar feature in the Mediterranean and the Eurasian land mass.

Today the bordering oceans, while affording protection from attack by foreign powers, offer the means of readily developing trade contacts with all the other continents. Here North America is particularly favoured by its longitudinal position between Asia on the west and Europe on the east.

The general contrasts between the east and west coasts of North America illustrate admirably the differences between the Atlantic and Pacific types of coast. Almost the whole Pacific coast of the continent is backed by mountains running parallel with the shoreline, giving a generally concordant coastline and making access to the interior very difficult. Much of the coast of British Columbia and Alaska has been affected by fracturing, glaciation and land subsidence. This has formed a characteristic pattern of island festoons and deeply trenched sounds and fiords.

On the east, a broad plain flanks much of the coast in the United States to give a coastline of low flat shores fringed with sandspits and shoals, while in Nova Scotia and Labrador the coastline cuts across the general grain of the landforms to create a discordant coast. Here are rias (or drowned river valleys) fiords and the islands which represent the higher portions of submerged ranges.

## Landforms and Structure

The general pattern of landforms in North America is simple. It consists of mountains on the east, much bigger and more extensive mountains on the west and plains between them, the whole of the landforms having a general north and south trend.

A more detailed division is shown in Figure 58. It has six major landforms differing in origin, appearance and economic activity. These are (with the numbers indicating them on Figure 58):

(a) The Laurentian Shield (1);
(*b*) The Appalachian System (2);
(*c*) The Ozark-Ouachita Uplands (3);
(*d*) The Western Fold Mountains (4, 5, 6);
(*e*) The High Plains (8);
(*f*) The Atlantic, Gulf and Interior Lowlands (7, 9, 10, 11).

**1. The Laurentian Shield** (Number 1, Figure 58). This low plateau surrounds Hudson Bay, from which the land surface rises gradually to the plateau rim along the Labrador coast in the east and the low Laurentian highlands in the south. Westwards, the almost level surface of the pene-

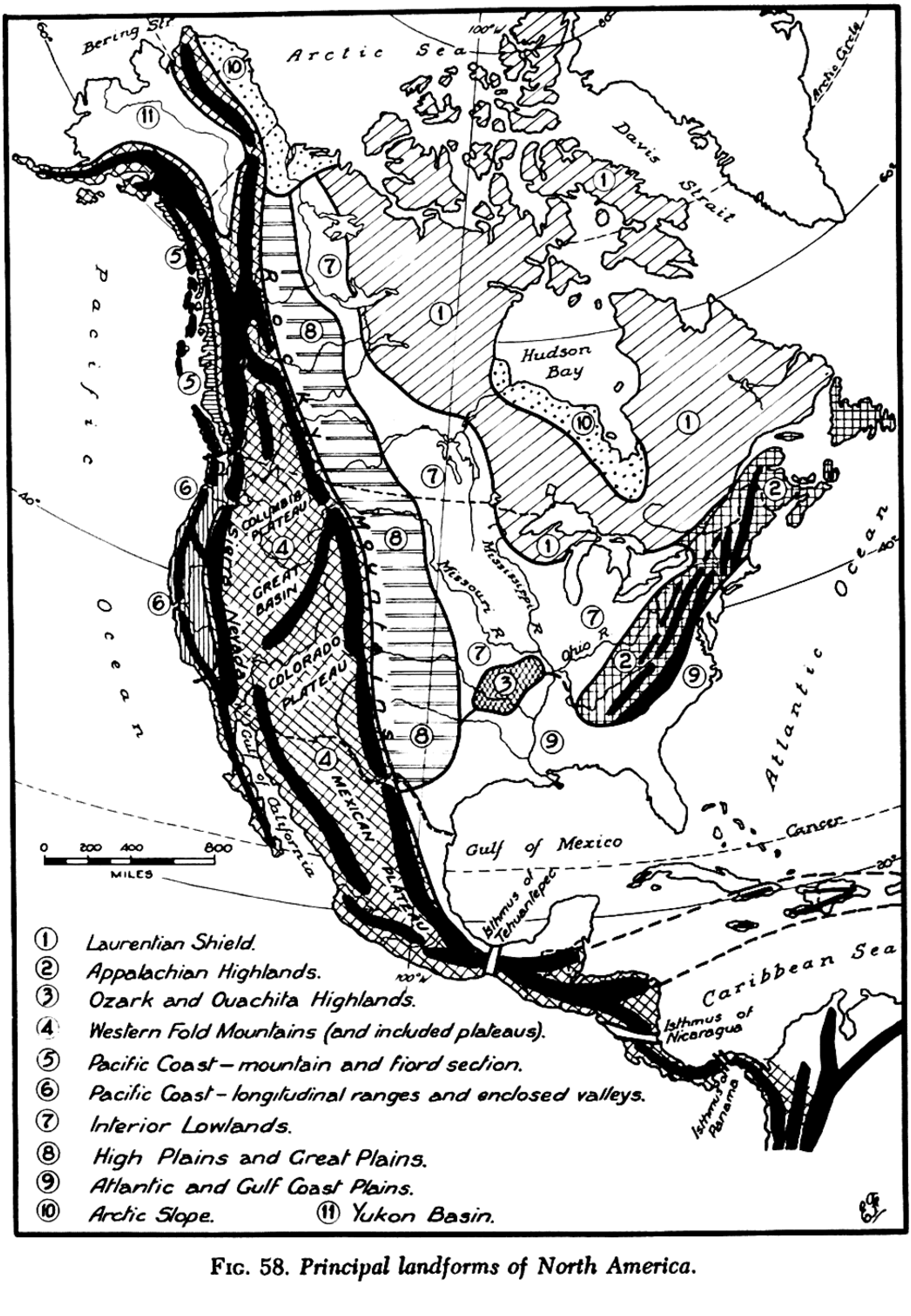


FIG. 58. *Principal landforms of North America.*

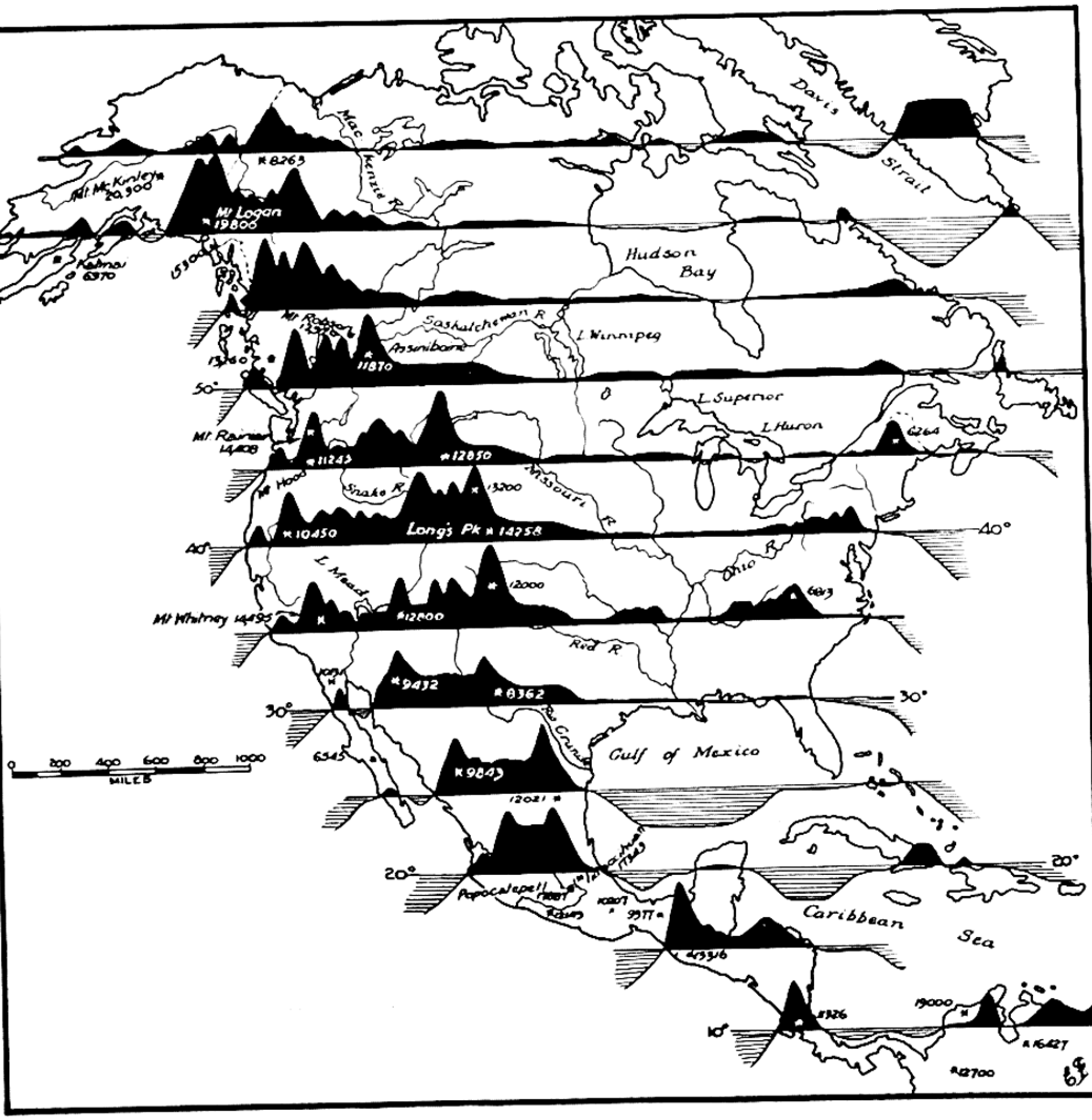


Fig. 59. *Sections across North America along each five degrees of latitude. Note that the projection used is one with straight parallels. It is an equal-area projection but distorts shape badly in Alaska.*

plain merges imperceptibly into the central lowlands, from which it is distinguishable only by its differing rock type. The Laurentian area consists of extremely ancient hard crystalline rocks (such as gneisses and schists), which form the oldest region on the continent. In pre-Cambrian and early Palaeozoic eras this was a mountainous area; but during the subsequent aeons of time the highlands have been worn down until only their stumps remain. This peneplain has been uplifted in comparatively recent times to form the Labrador highlands and the Adirondacks offshoot in the United States. The shield is generally regarded as being the nucleus round which the American continent was built. It has mostly been above sea-level since Palaeozoic times and to it has been added the rest of the continent.

The whole of the Laurentian shield has been greatly affected by ice

action. The soil has been scraped from many parts of the area, leaving the rocks bare and scratched with many scooped-out hollows that have been filled with water to form a bewildering pattern of lakes. Elsewhere patches of soil have been left in the hollows and valleys, and it is on them that the coniferous forests grow.

The general drainage of the area has been greatly altered and generally confused by the ice movement and the dumping of rock waste across old drainage lines.

Much of the country is of little economic value except for occasional rich deposits of minerals. The whole area is so typical of ice action on both a continental and a smaller scale that it will be as well to study glaciation generally at this point.

### Glaciers and Ice Erosion.

Glaciers and permanent ice sheets develop where temperatures are sufficiently low to allow for the accumulation of snow. Fallen snow is removed by evaporation, melting and rain washing, and these are much less active and effective under low temperatures. The essential condition for permanent snow is therefore low temperature, specially in summer. Such conditions occur in polar areas and on mountains above the snowline. The height of the snowline varies over the earth in an approximate accordance with sea-level temperatures. It is about 16,000 to 18,000 feet in equatorial and tropical regions and falls steadily to approximately 8000 feet at latitude 40°, 3000 feet at latitude 60° and sea-level near the poles. In Australia it just clears the highest mountains. Were Mounts Kosciusko and Buffalo about 1000 feet higher the snow patches, which now linger on shaded southern slopes until autumn, would form part of a permanent snow cap. Only in Arctic and Antarctic regions do we find extensive areas of lowland (or ocean) permanently ice and snow-covered. It must not be thought that all land north of the Arctic Circle (or south of the Antarctic Circle) is ice covered. Much of the lowland of northern Canada and Siberia receives an insufficient snowfall to allow for accumulation into ice fields. The very light snowfalls of the winters there are melted during the short summers.

Snow and the ice which forms from its packing together erode the mountain areas where they occur in a very characteristic fashion. In glaciated highlands, not all the ground above the snowline is snow covered. The snow collects on gentler slopes and in hollows, leaving the high peaks sticking out sharp and jagged in form. The snow-filled cols and hollows serve as the feeding ground for valley glaciers. Pressure transforms the powdery snow into granular ice called *névé*, and this flows slowly off in tongues down the valleys. The movement of the huge masses of ice is slow (from a few feet to several hundred feet a year) but inexorable. The enormous weight of the glaciers (often many millions of tons) and the large amount of rock material included in them, gouges out the valleys down which they move until they form the characteristic deep steep-sided U-shaped valley of glacial erosion. Should the glacier follow an old river valley, it tends to plane off the spurs round which the river wound its way and leave them as steep cliffs called *truncated spurs* (see Figure 60). The ridges and peaks at the head of the glacial valley are sharp and jagged.

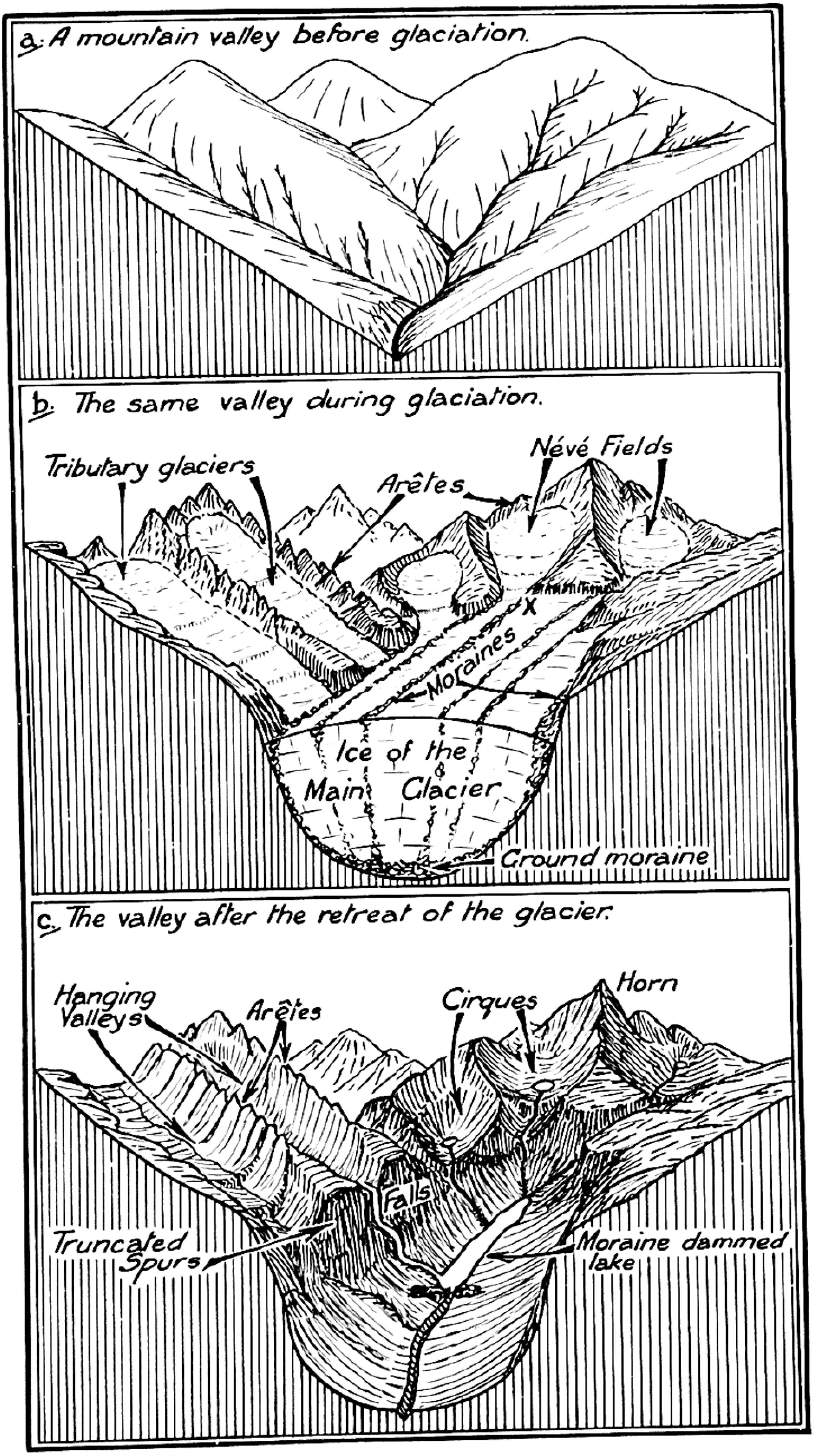


FIG. 60. *Sketch diagrams to show the development of glacial landforms in a highland area. (Suggested by a diagram in Preston E. James, "The Geography of Man".)*

The rock material carried by glaciers is called *moraines* and various names are given to it according to its location in the ice stream. Thus the *lateral moraines* flank the glacier's sides, while the *ground moraine* lies under the ice on the valley floor. Should two glaciers meet, the lateral moraines on one side of them will unite to form a strip of rock material down the centre of the combined glacier. It is then called a *medial moraine* and in some very large glaciers, formed by the union of many smaller ones, several medial moraines are noticeable (see Figure 60). At the end (or snout) of the glacier, where it melts to form a river, a heterogeneous mass of morainic material is dumped by the melting ice. This is called a *terminal moraine* and it often creates a dam across a glacial valley behind which a lake forms as the ice retreats towards higher ground. Many of the lakes in the European Alps were formed in this manner.

The effects of glaciation can best be seen when warmer climatic conditions cause them to shrink and finally to disappear. It is then that the characteristic landform features sketched in Figure 60 can be noted clearly. Here it was assumed that glacial conditions appeared in a high mountain area previously eroded by river action. Figure 60(a) shows the pattern of steep-sided valleys with overlapping spurs which characterises river erosion in mountain areas. Figure 60(b) represents the area at the height of glaciation, when the ice action has been going on long enough to alter drastically the shape of the valleys and the appearance of the exposed ridges and slopes. Several important features of above-snowline landscapes are indicated on this sketch. First, notice the sharp knife-like ridges, often with serrated edges, that separate the various glacial valleys and form the skyline. These are caused by frost action chipping off rock fragments, which then fall to the glacial ice to form moraines, and by the "plucking" action of the glacial ice itself as it moves away from the valley sides. Such ridges are called *arêtes*. Next, note the manner in which the snow collects to form the névé fields. The basin shape of the névé field comes from ice plucking round the edges of the hollow. Thirdly, the tributary glaciers are much smaller than the main glacier, and their erosive power is much less. The fine shading lines crossing these glaciers are to indicate crevasses and occasional ice falls where the ice tumbles over an irregularity in the valley floor. Finally, notice the features of the main glacier, which has been formed by the union of several tributary glaciers. It rides in a deep U-shaped valley carved by its enormous weight and it has considerable moraine material both on its sides and bottom and in streamers through it. These are the medial moraines and are caused by the union of two lateral moraines as the tributary glaciers meet the main one as at "X". Notice that these medial moraines extend throughout the ice as well as showing on the surface. In some glaciers this moraine material is at least equal to the amount of ice, and in the Malaspina glacier of Alaska it is so great in amount that a five-mile wide forest of stunted pines and junipers is growing in the moraine material near the glacial snout. This fact is also an indication of how slowly many glaciers move.

Figure 60(c) shows the landform features in the valley after the glacier has disappeared. First, notice the deep U-shaped trough of the main valley with its broad, rather flat bottom and precipice-like sides. A *moraine-dammed lake* is shown occupying part of this valley and a stream has started to cut a channel from it. Such valleys as these are very common in the European

Alps and other high mountain areas where glaciation has occurred or is still present. The Lotschental and Lauterbrunnen valleys of Switzerland and the Brenner Pass between Italy and Austria are excellent examples of glacier-formed valleys.

Secondly, the *truncated spurs* flanking the valley trough have been formed by the glacial ice planing off the ends of the overlapping spurs of the pre-glacial river valley. Ice, because of its weight, tends to move in a fairly straight path down the valleys, pushing aside smaller obstacles and planing off larger and harder ones.

Thirdly, note the sharp *saw-toothed arêtes* separating the side valleys and the horn at the head of the main valley. A peak such as this is the famed Matterhorn on the Swiss-Italian border.

Fourthly, the *cirques* (or *corries*, as they are called in Scotland) are the basins formed by the plucking of the névé snow and ice. Cirques are ringed by steep, angular-topped cliffs and generally have a lip of rock across their lower edge with a small lake in the hollow behind it.

Finally, the valleys of the tributary glaciers now stand at a much higher level than the main valley because the smaller amount of ice in them was unable to cut them down at the same rate as in the main glacier. These are called *hanging valleys* and are characteristically U-shaped with the streams flowing along them and tumbling into the main valley by a series of waterfalls. Such waterfalls are one of the outstanding scenic attractions of pre-glaciated landscapes, as well as affording potential hydro-electric power for surrounding areas.

Where glaciers descend to sea-level they form a characteristic fiord coastline. Figure 61 shows examples of such coastlines in western Canada and south-western Norway. Note carefully that the maps are drawn on different scales. Similar coastlines occur in southern Chile, the South Island of New Zealand, western Scotland, south-western Tasmania and Greenland.

In every case the coast is backed by upland areas in which the glaciers have carved deep valleys. Notice the heights shown on the maps in Figure 61. The Norwegian area is a plateau of 3300-3500 feet in height, with peaks rising to 8000 feet, while the Canadian coastland rises to over 5000 feet. In carving out these finger-like fiords the glaciers deepened them to far below sea-level—often over 1000 feet below—so that when the ice retreated they became deep silent waterways and inlets, flanked by towering cliffs and with little or no level land along their sides or at their heads. Such fiords afford wonderful sheltered harbours, but their cliff walls make them of very little value as seaports, as it is almost impossible to build land communications to them; and a seaport cannot be any greater than its land transport routes permit.

Examination of both maps will show that branching fiords form an island fringe to the coasts. This is known as the *skerry guard*, and it affords a sheltered, though tortuous, waterway along the coastline.

The protected coastal waterways of the Norwegian coast, together with the difficulty of access to the interior and the absence of level farmland, has forced the Norwegians to turn to the sea. As the Norsemen they were among the most venturesome seamen of early times and today they are one of the greatest seafaring nations in the world.

*Yosemite* (an example of a glacier-carved valley). Figure 62 is a sketch diagram of the Yosemite Valley of central eastern California. In it will

be seen features of a previously glaciated landscape. After being worn down to a granite peneplain during the late Miocene, the area was uplifted approximately 6000 feet during the Pliocene. The Merced and Tenaya rivers cut youthful valleys up to 1000 feet deep in this uplifted peneplain. Then came the Pleistocene snow fields and ice from which a glacier flowed down the Merced Valley and another down the Tenaya Valley. The two glacial streams moved through the Yosemite section and flowed (off the bottom of the sketch) down to 4000 feet above sea-level. This glacier deepened the already deep Yosemite Valley by 600 feet at its lower end and 1500 feet at the upper end, and widened it to about three-quarters of a mile. The granite walls of the valley, rising in places as sheer precipices 3000 feet high, were planed off and made vertical by the abrasion of the moving ice.

The erosion of the wide Yosemite Canyon was achieved by the undercutting of the ends of tributary streams and the truncating of the ends of

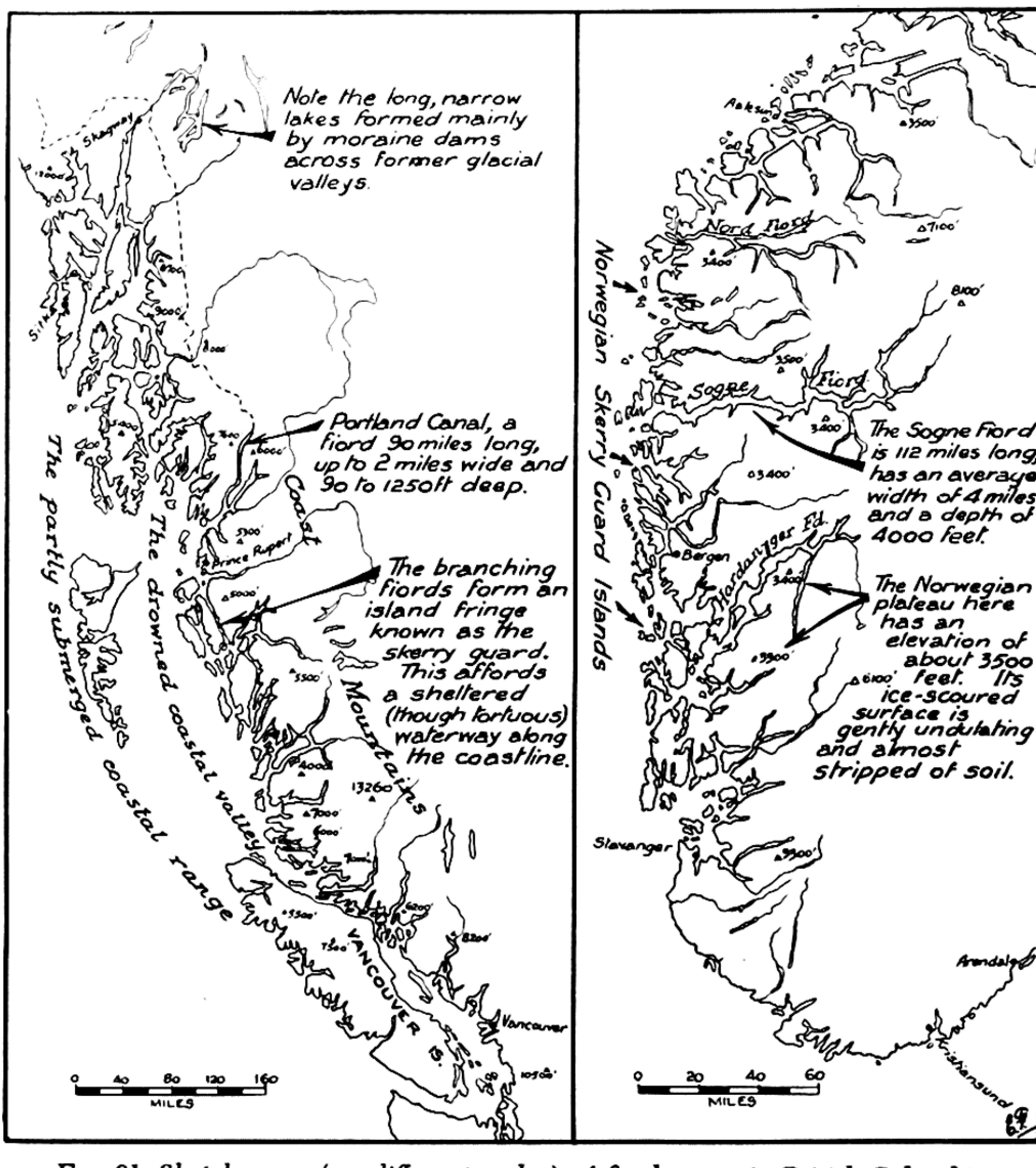


FIG. 61. *Sketch maps (on different scales) of fiord coasts in British Columbia and south-west Norway.*

interfluves between them. As a result the tributary streams are left in hanging valleys and their waters now come into the main valley over waterfalls of considerable height and great beauty. Such falls are the Bridal Veil (620 feet sheer drop), Ribbon Falls (1612 feet drop) and Yosemite Falls (2425 feet in three drops).

The truncated spurs stand out as cliffs of granite rising high above the valley floor: Half Dome (see Figure 62) is 4770 feet above the valley, Washington Column 1830 feet, Glacier Point 3300 feet and the majestic El Capitan 3600 feet.

At the end of the last glaciation a terminal moraine blocked the lower end of the valley and formed a lake which occupied five miles of the floor. The filling of this post-glacial lake has created a level *lake-filled plain* now occupied by a beautiful tree-dotted and flower-sprinkled meadow set in this area of striking bare cliffs.

*Ice sheets.* One of the most significant events of the last million years of the earth's history (i.e., the Pleistocene Age) was the alternate freezing and thawing experienced during the Ice Ages. The chilling of the climate

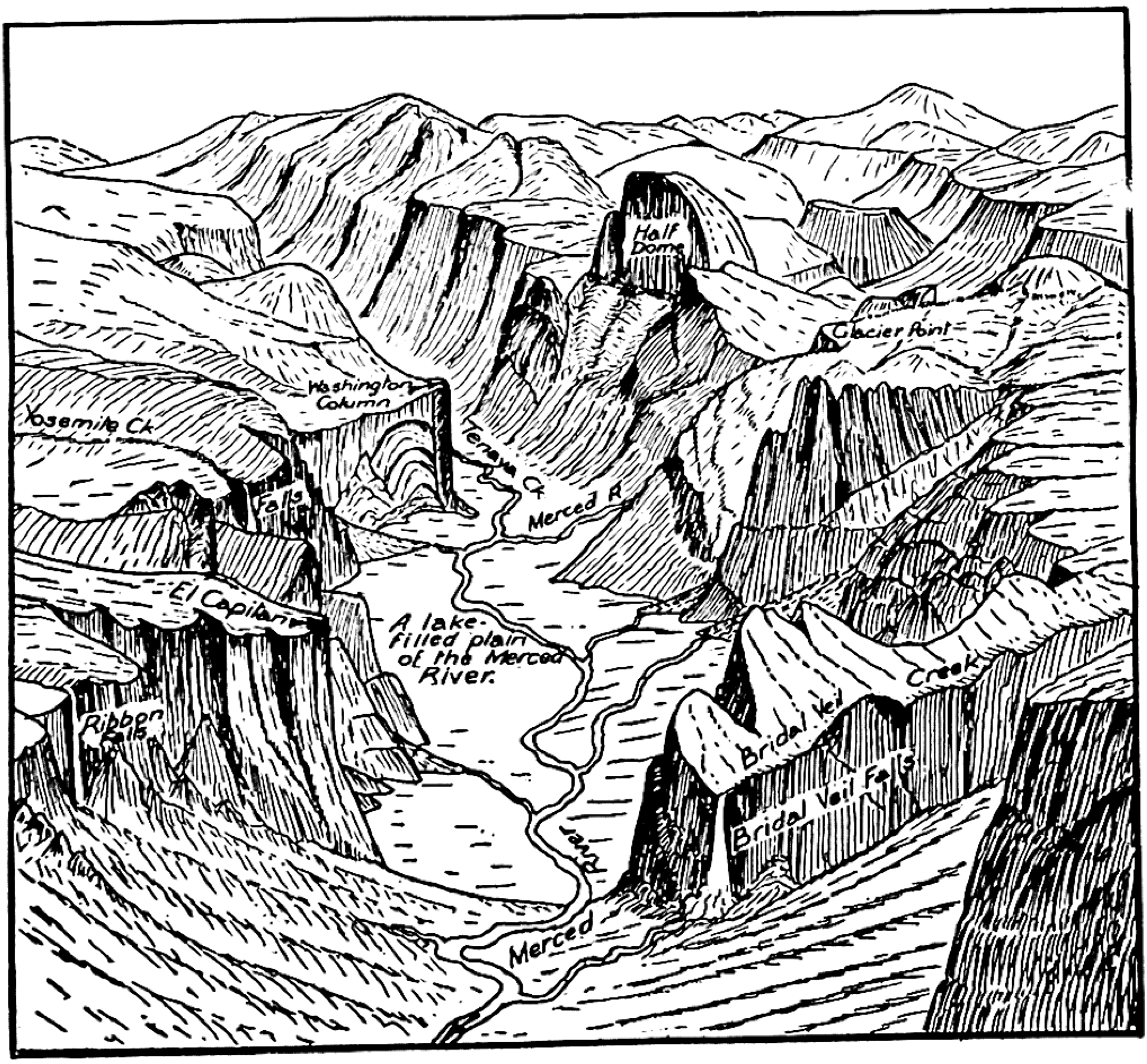


Fig. 62. *Pictorial sketch of the Yosemite Valley in California (after Frederic B. Loomis).*

was world-wide, but its effects were most marked in the northern hemisphere, particularly in North America. Here, there were at least four glacial periods separated by warmer interludes. During the cold periods great sheets of ice, similar to those now occurring in Antarctica or Greenland covered the land to a depth of several thousand feet. At the same time the upper parts of most mountain areas were also covered with accumulations of ice and snow from which glaciers pushed their way down existing river valleys towards lower land, altering the landforms in the manner discussed above (Figure 60). Under climatic conditions where the snow of one year is not all melted when that of the next year begins to fall, great masses of snow tend to accumulate on the ground. Should these conditions prevail for some thousands of years, the collected snow packs into ice and slowly spreads out under its own weight over the land in the form of an ice sheet. During the Pleistocene Age such ice sheets covered nearly four million square miles of North America and a somewhat smaller area of north-west Eurasia (see Figure 63). These sheets were over 2000 feet thick

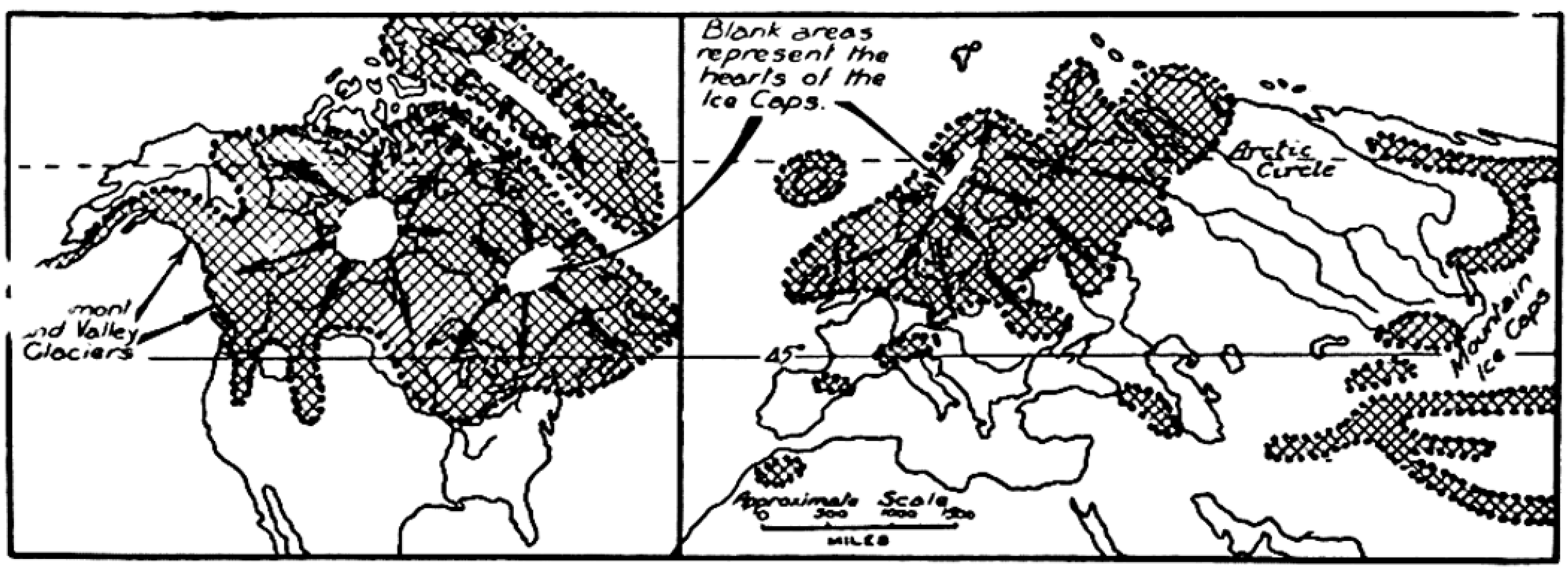


FIG. 63. *Maps to show the maximum extension of ice sheets during the Ice Ages in North America and Eurasia.*

and when we realise that one square mile of ice 1000 feet thick weighs approximately 70 million tons, we can appreciate what a massive erosive tool a moving ice sheet is.

The passage of this enormous weight of ice over irregular ground tends to plane off and smooth over the higher irregularities and to scoop out any patches of softer rock. It removes much of the soil cover though it may also form patches of soil by grinding rock material in its passage. Towards the front of the sheet enormous masses of moraine material will be deposited to form irregular patterns of hills composed of heterogeneous rock material. Such hills are found in mid-west and north-east United States, and in Germany, Poland, the Baltic States and north-west Russia in Europe. Hundreds of streams from the melting ice carry much of this moraine material from the front of the sheet and spread it as fertile glacial outwash plains for thousands of square miles along the margins of the ice sheet. Some of the best farmland in North America and northern and western Europe is composed of clays and silts formed in this manner (see Chapter XXV).

On the retreat of the ice sheet because of warmer climatic conditions, a profoundly altered landscape is revealed. The whole countryside has been planed by the ice and has a smooth and rounded appearance, while thousands of lakes of all shapes and sizes occupy either scooped-out hollows or valleys dammed by moraine material. The soil has mostly been removed from the higher ground, which stands out stark and bare, to pockets in hollows. Here vegetation grows to give a touch of life and colour to an otherwise drab landscape. Figure 64 suggests the main features of such a landscape, which abounds in Canada, Finland and Scandinavia, but you should endeavour to collect and study aerial photos of these areas in order to get a true appreciation of their appearance. Some of the glacial lakes and waterways may be very large and of great significance in the present-day economic development of the countries where they occur. The Great Lakes of North America, formed by the ice sheets, are perhaps the

Fig. 64. *Sketch diagram of an area scoured by the passage of an ice sheet.*

greatest inland waterway in the world, while the very significant Hudson-Mohawk Valley gap through the Appalachian highlands is also glacier-carved.

One interesting result of the melting of the ice sheets is the rise of the land where they occurred. Scandinavia is estimated to have risen several hundred feet since the final melting of the great ice cap once covering it.

A second important result of ice melting was a general rise of about 180 feet in sea-level throughout the world. This drowned many river valleys to form harbours and estuaries.

**2. The Appalachian System** (Number 2, Figure 58). These highlands stretch for nearly 2000 miles from Alabama to Newfoundland. They consist of several longitudinally parallel landforms which are distinct in character. These are shown in the section (Figure 65), and from west to east they are:

(*a*) *The Alleghany Plateau*, composed of horizontal strata dipping gently westwards to the inland plains and on the east falling by a steep

scarp to the Appalachian valley. The plateau has been severely dissected by many rivers which now run in canyons several hundred feet in depth. Transport, except along the valley floors, is difficult, but the plateau is rich in minerals. It lies over the world's greatest bituminous coalfield, the seams of which have been exposed in the valley walls and floors, so that mining is easy (see Figure 65). Petroleum and natural gas are also present in considerable quantities.

(*b*) *The Appalachian Valley* stretches from the St Lawrence River to Alabama. Its width varies considerably and rarely exceeds 25 miles. In the north it consists of the Hudson and Champlain valleys, which have been affected by glaciation. In the centre and south it has always been a natural highway for settlers moving inland. They left it by way of the famed Cumberland Gap north of Knoxville (Tennessee) on the border of Kentucky and Tennessee.

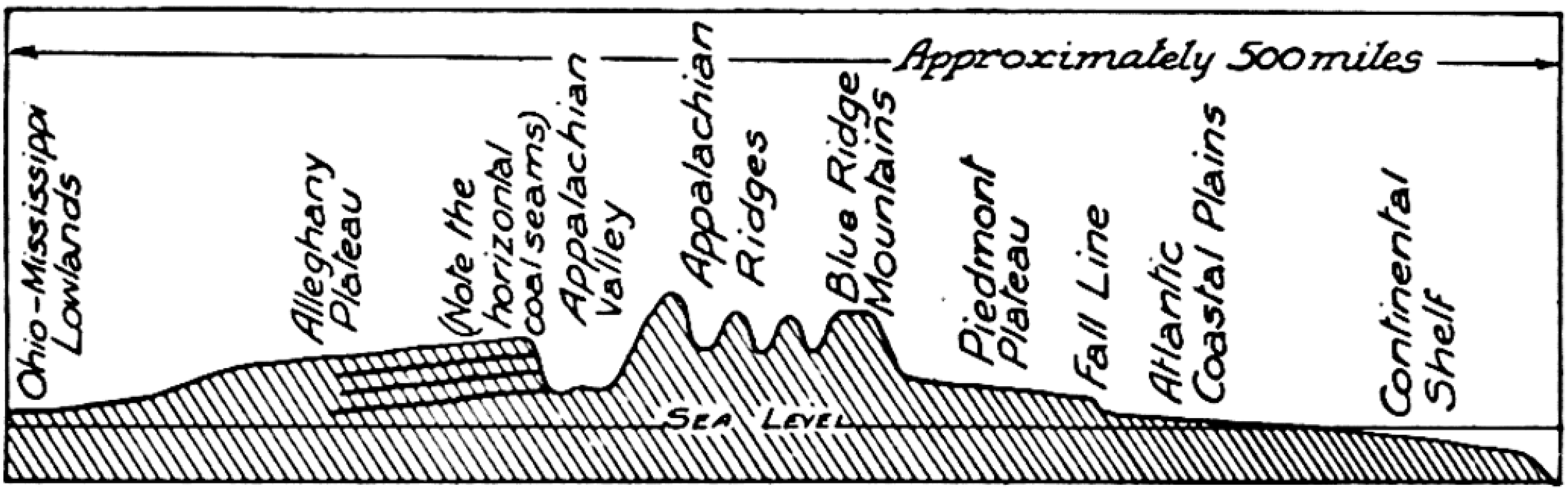


FIG. 65. *Generalised cross-section of the Appalachian Mountains in North America.*

(*c*) *The Appalachian Ridges* consist of a series of high parallel ranges of sedimentary rocks which were slowly folded on a north-east to south-west alignment. The arches of the original folds were worn down to a low plateau surface which was again uplifted and eroded. On this occasion the rivers cut their channels in softer rock bands to leave the hard bands as regular parallel ridges. Several rivers, such as the Delaware, Susquehanna, Potomac and James, have cut their valleys across the ranges to reach the east coast. We have therefore a pattern of longitudinal valleys occupied by tributary streams and transverse valleys cut by the main rivers. The general pattern of settlement throughout the Appalachian Ridge section is in the flat-floored longitudinal valleys, while the transverse valleys serve as important avenues of transport for railways and roads crossing the mountains (see Ford and Rowe, *Regions and Men*, page 27).

The ridge country is flanked on the east by an eroded, upthrust horst of metamorphosed Pre-Cambrian rocks. It is known generally as the Blue Ridge Mountains, though in the south, where it splays out somewhat, it has various names, among which are the Great Smoky, Black and Bald

Mountains. North of the Hudson the Appalachians have been ice-carved and contain many beautiful lakes in ice-deepened valleys. Various names, such as the Green Mountains, White Mountains and Notre Dame Mountains are given to the system in this area. All of these are important as summer and winter recreational areas for the peoples of the overcrowded cities of the north-east United States industrial and commercial region.

The Hudson-Mohawk gap is the most important transverse valley of the Appalachians, as it gives an almost sea-level route from New York to the Great Lakes and the mid-west farming province. It owes its being to the Ice Age. The Hudson is a partly drowned glacial-deepened river valley that ends in the excellent New York harbour. The Mohawk was cut by an outlet river from the Great Lakes running along the front of the ice sheet at a time when the St Lawrence was still blocked by ice.

In comparatively recent times the northern part of the Appalachians has sunk to form a series of islands such as Newfoundland, Cape Breton and Prince Edward. This has reduced the coastal plain but has created excellent harbours and helped to form the fishing grounds known as the Grand Banks.

(*d*) *The Piedmont Plateau*. Fronting the Appalachians on the Atlantic side is a region of undulating hill and valley country known as the Piedmont Plateau. Like the Blue Ridge Mountains it is composed of Pre-Cambrian rocks, and its surface slopes gently upwards from 400 feet on its eastern edge to 1200 feet where it meets the Blue Ridge block. The eastern margin of the Piedmont Plateau is called the Fall Line because the rivers from the Piedmont descend to the adjacent Atlantic Coast Plain either by falls or rapids. The Fall Line has determined the location of cities from Trenton (New Jersey) to Columbus (Georgia), as the rapids and falls have marked the head of navigation and also provided power for establishing early industries. The cities whose location has been determined by the Fall Line are Trenton, Philadelphia, Baltimore, Washington, Richmond, Raleigh, Columbia, Augusta, Macon and Columbus.

**3. The Ozark-Ouachita Uplands** (Number 3, Figure 58) break the continuity of the interior lowlands in Arkansas and Oklahoma. These highlands are an uplifted peneplain of folded Palaeozoic rocks that has been deeply eroded by subsequent river action. Drilling by oil companies has confirmed the fact that they are a continuation of the Appalachian system with the connecting section buried deep under the sediments of the lower Mississippi Valley.

**4. The Western Fold Mountains** (Numbers 4, 5 and 6, Figure 58) are the most striking landforms in North America. They stretch the whole length of the continent from Bering Strait to Panama, and in the United States the system attains a width of over 1000 miles. Figure 58 and the series of sections on Figure 59 show two great belts of mountains, the Rockies on the east and the Coast (or Pacific) Ranges on the west. Between them, in

the United States and Mexico, lies a jumbled series of ranges and enclosed plateaux and basins known as the Basin and Range Province. In general, the main ranges run parallel to the coast (i.e., they are a concordant system). They form a pronounced climatic barrier as well as a formidable obstruction to communications running across the continent. This mountain system is much younger than the other highlands in North America, and it was formed during late Tertiary times by the folding, fracturing and uplifting of both young and very old rocks on a gigantic scale. Figure 66 suggests something of this in the number of blocks and major faults shown on it. The upheavals were accompanied by much volcanic activity. Active volcanoes and earthquake zones are still present. Many of the most prominent peaks are dead or dormant volcanoes and in the past great areas were covered by lava flows from them. The major sub-regions here are:

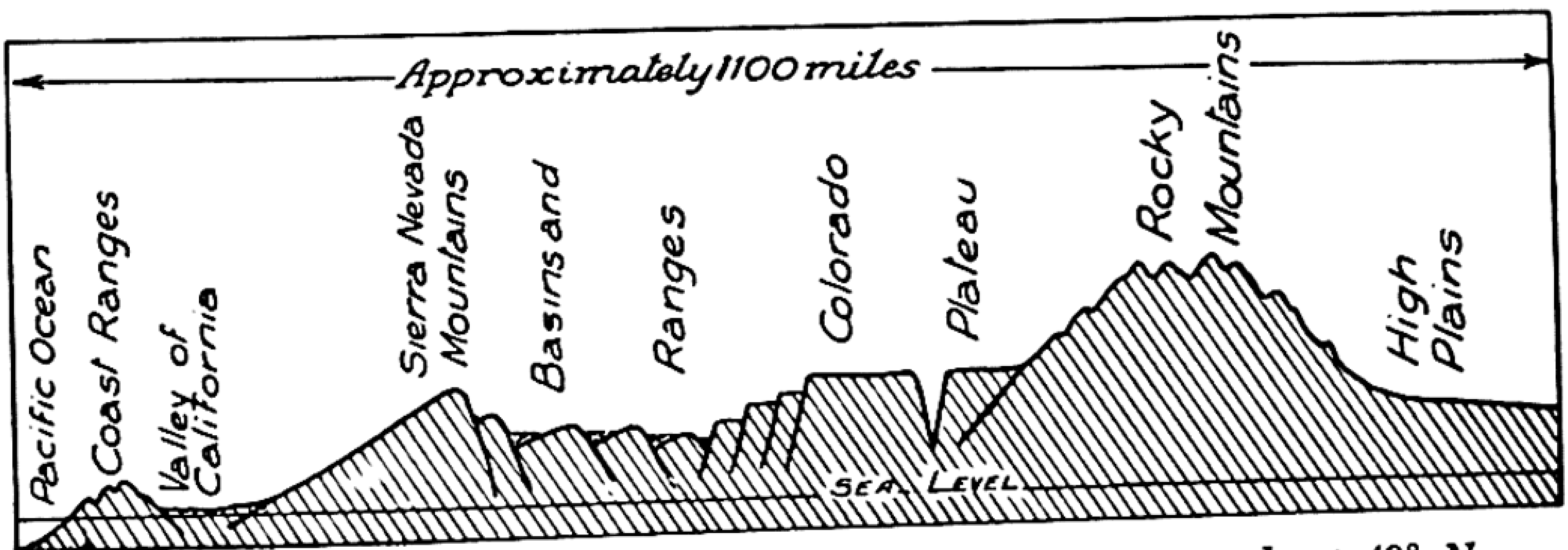


FIG. 66. *Generalised cross-section of the Rocky Mountains at about 40° N. latitude.*

(*a*) *The Rockies.* The northern Rockies extend through Canada from Alaska to the Missouri River and have many peaks over 10,000 feet in height. They possess the grandest scenery in North America. Here the highest peaks are always snow-covered, and there are many glaciers in the high valleys. Rivers tumble down in magnificent falls to quiet and beautiful lakes nestling peacefully amid sombre pine forests. The railways and roads use several passes through the Canadian Rockies, the better known ones being Kicking Horse Pass, Yellowhead Pass and Crow's Nest Pass.

South of the Missouri the Rockies pass into the Laramie Plateau across which lies the easiest natural route to the west coast. It was followed first by the Oregon Trail in the "prairie schooner" days and later by the Union Pacific Railroad. Southward again the Rockies attain greater height in an area where 13,000 to 14,000-foot summits such as Pike's Peak (14,110 feet), Long's Peak (14,255 feet), Gray's Peak (14,274 feet) and Blanca Peak (14,390 feet) represent granite monadnock remnants standing on an uplifted peneplain of some 9000 to 10,000 feet elevation. It was

here that the bold barrier, rising rocky and bare from the High Plains, was given the name Rocky Mountains by the first settlers.

South of the Rio Grande the Rockies are continued as the Eastern Sierra Madre which form the eastern ramparts to the Mexican Plateau (see Figure 59).

(*b*) *The Pacific Ranges* (Numbers 5 and 6, Figure 58) are known by various names. As Figures 58 and 59 show, two distinct lines of mountains may be distinguished: an outer fold consisting of the Alaska, St Elias, and Coast Ranges, which continues into the Peninsula of California; and an inner series of mountains forming the Cascades, Sierra Nevada and Western Sierra Madre in Mexico. Between these two lines a more or less continuous valley may be traced. In the north it has been drowned to form Puget Sound, Queen Charlotte Strait and Hecate Strait. It is flanked on the seaward side by many islands which are the tops of the drowned mountain range. South of Puget Sound the depression is continued as the Willamette Valley and the Valley of California and beyond that as the Gulf of California. The northern portion shows the effects of Ice Age glaciation and its fiorded coast is mapped in Figure 61.

The Cascades and Sierra Nevada ranges consist of uplifted blocks of very old rocks rising to an average height of 7000-8000 feet with occasional monadnocks such as Mount Whitney (14,496 feet) standing at much greater heights.

The Sierra Nevada of California is a great uplifted block 500 miles in length and tilted so that its western slope dips gradually towards and under the alluvial plains of the Great Valley of California, while its eastern flank fronts the Nevada Basin and Range country as a bold scarp (see Figure 66). The streams draining the gently sloping western face of the Sierra block cut deep gorges into it as the uplift was taking place. During the Ice Ages the upper portions (from 8000 feet down to 4000 feet) were glaciated. These stream and glacier-cut gorges, often over half a mile deep, form some of the most striking scenic features of the Sierra Nevada (see Figure 62 and the discussion on Yosemite Valley).

(*c*) *The Great Valley* (Number 6, Figure 58) lies between the Coast Ranges of California and the Sierra Nevada. It is 500 miles in length with an average width of 50 miles. It represents a deep structural valley, flanked by faults, which has been filled with sediments from the adjoining highlands. This filling material came mainly from the wetter western slopes of the Sierra Nevada and was spread out as delta deposits in the waters of the originally submerged valley. When the valley surface reached sea-level the deposition continued as alluvial fans which spread and coalesced to form a broad piedmont alluvial plain along the base of the Sierra Nevada. These fans have steadily pushed the San Joaquin River well over to the western side of the valley, and its tributary streams from the east now reach it after flowing over the deep alluvial material of their own building. In the extreme south of the valley the fan of the King River made a dam behind which Tulare Lake, fed by the waters of King and

Tule rivers, has formed. On this sloping piedmont plain is a definite zonation of crops, with three types of farming running in parallel belts north and south along the valley. Fruits are grown on the higher parts of the fans near the mountains, with citrus fruits on the highest land and grapes and stone fruits lower down on the middle slopes. These orchard trees benefit from air drainage (i.e., the settling of colder, and heavier air in the valley bottoms on still cold nights) and from larger water supplies, which can be used to irrigate the warmer porous soils of the upper fan areas. The heavier, finer and more water-retentive soils of the valley bottom (i.e., the outer margin of the fan deltas) grow frost tolerant crops such as lucerne, barley, sugar beet and beans, and support dairy cattle.

(*d*) *The Basin and Range Province* (Number 4, Figure 58). This area extends from the upper valleys of the Columbia and Fraser rivers in British Columbia to central Mexico.

While the uplift was taking place in the Rocky Mountains the sections to the west of the main mountains—the Columbia and Snake plateaux, the Basin and Range Province, the Colorado plateaux and the Mexican plateaux—yielded to the strain and broke into a mosaic of blocks. In the Colorado Plateau the rocks were not tilted, but in the other three areas the rocks were fractured and tilted to form regions of great complexity of rock structure. Here the uptilted blocks stand out as short ranges with the intervening valleys being filled with debris eroded from the surrounding mountains. The aspect of these mountains to be seen from the intervening valleys depends on whether the escarpment along the fault face or the gentler back slope is observed.

In the Canadian portion the Selkirk and Cariboo ranges form the western boundary of a longitudinal valley 600 miles long. The upper courses of the Fraser, Skeena and Columbia rivers lie in this valley, and from it they have cut transverse valleys through the intervening ranges to the Pacific Coast. These valleys are now followed by the main roads and railways crossing the mountains.

In the Columbia River section the volcanic activity of the middle and late Tertiary period poured out enormous amounts of a very fluid lava which filled the hollows and buried the mountains to make a broad plateau over the middle and lower Snake and Columbia valleys.

South of this plateau and extending to the west of the Colorado Plateau lies the Basin and Range Province proper, with its hundreds of short asymmetrical ranges and sediment-filled valleys. Much of the area is endoreic (inland draining) and the Great Salt Lake in Utah and Lake Carson in Nevada represent small remnants of once great inland drainage lakes (Lakes Bonneville and Lahotan).

The Colorado plateaux extending from eastern Utah to Arizona and New Mexico represent an area of uplifted horizontal strata. It has been severely eroded by westward flowing streams of which the Colorado is the most significant. Elsewhere the rocks show fantastic patterns as the result of differential wind and water erosion on rocks of varying degrees of

hardness (e.g., Bryce Canyon). The river-cut canyons are of great size, depth and beauty, in many cases many miles in width and up to one mile in depth. The Mexican Plateau consists of a series of ranges and troughs that have been almost completely filled in with volcanic materials. Along its southern edge is a chain of lofty volcanoes now mostly extinct. Among them are Popocatepetl (17,780 feet and active), Orizaba (18,250 feet), Ixtaccihuatl (17,843 feet) and Colima (12,990 feet and active). Earthquakes are frequent here, especially on the Pacific side, where a continuation of the notorious San Andreas fault (of San Francisco earthquake notoriety) extends down the eastern shore of the Gulf of California.

**5. The High Plains and Great Plains** (Number 8, Figure 58) consist of marine beds of shales and sandstones elevated during the Tertiary period with very little disturbance of their structure. They extend from the Rio Grande in a belt up to 400 miles wide far into northern Canada, with the Great Plains forming the lower eastern half and the Miocene sands, gravels and clays forming the more elevated High Plains to the west. The area as a whole appears as a wide undulating surface sloping gently down from nearly 6000 feet along the Rocky Mountain edge to about 1500 feet, where the Great Plains meet the Central Lowland (at approximately 100° W. longitude). The streams have entrenched themselves in deep canyons in the High Plains north of the Red River in Texas, but flow in shallow valleys across the Great Plains and Central Lowlands. South of the Red River the Staked Plain and Edwards Plateau, part of the High Plains, make a great upland of some 60,000 square miles. No streams have cut canyons here, for the slight rainfall sinks into the sandy ground to come to the surface around the borders of the High Plain. This part of the High Plain is bordered by a bold escarpment from 300 to 1000 feet in height. It has been maturely dissected, so that it appears as a range of wooded hills known locally as "The Mountains".

**6. The Lowlands** comprise the Atlantic, Gulf and Central (or Interior) Lowlands, the Arctic Slope and the Yukon Basin.

(*a*) *The Atlantic Coast Plain* (Number 9, Figure 58) extends from New Jersey to Alabama. It is composed of a sea bottom raised slightly above sea-level. The present surface soil is a mantle of reddish sandy loam 30 feet thick. Waves and currents have thrown up barrier beaches along many parts of the shoreline. Behind them is an almost continuous series of lagoons and swamps. In other places submergence has formed deep inlets such as Chesapeake Bay, Delaware Bay and New York Harbour. Much of the land surface is poorly drained and swamps are common, especially in Florida, where the low-lying level limestone is pitted with hundreds of lakes in sink holes.

(*b*) *The Gulf Coast Plain* (Number 9, Figure 58 has a different physical structure from the Atlantic Coast Plain. The surface of the Gulf Coast Plain in the United States consists of a series of sedimentary rock

layers of varying degrees of hardness tipping towards the sea and rising steadily inland. Erosion of the weaker layers has left the harder ones standing out as a series of parallel ridges with steep north-facing bluffs (called cuestas) each overlooking a broad interior lowland valley running parallel to the coastline. Settlement tends to follow the broad east-west valley floors, leaving the ridges as unoccupied land. The Mississippi cuts through this formation in a broad deep trench 50 to 70 miles wide filled with alluvial material over 1000 feet deep. This flood plain is flanked by bluffs from 100 to 200 feet in height. The river meanders across the flood plain, often changing its course during and after floods and mostly flowing between levees with its bed above the level of the adjoining lowland.

The Gulf Coast Plain narrows in Mexico, but east of the Isthmus of Tehuantepec it widens out to form the limestone Yucatan Peninsula. Almost everywhere the low-lying coast is fringed with lagoons and swamps enclosed by islands of sand and shingles heaped up by winds, waves and tides.

(*c*) *The Central* (*or Interior*) *Lowlands* (Number 7, Figure 58) extend in an almost unbroken belt from the Gulf Plain to the Arctic Ocean. The present surface is that of a lowland peneplain, with much of it part of an old sea floor rich in limestone. Its northern portion (north of the Ohio and Missouri rivers) is largely covered with ground moraines deposited during the continental glaciation or consists of glacial outwash plains. These soils are generally fertile, though in places their agricultural usefulness is marred by large numbers of included stones and boulders. Recent slight uplift of much of the lowlands has enabled the rivers to extrench their valleys up to 200 feet in the lowland surface. South of the Ohio-Mississippi junction the land is essentially composed of the alluvial deposits of the lower Mississippi Valley.

Along the margin of the retreating ice sheet large lakes formed in hollows where the northward drainage was blocked by ice. Such was the so-called Lake Agassiz, which once occupied over 100,000 square miles of the Canadian and North Dakota prairies. During its existence glacial streams carried immense quantities of silt to be spread over its bottom. On the retreat of the ice sheet the lake drained northwards via the Nelson River into Hudson Bay and shrank in size until only Lake Winnipeg and a few nearby smaller lakes remained. Its thickly sedimented bottom became the rich prairie wheat-growing area of the Red River Valley and Manitoba and North Dakota.

The Great Lakes were also formed during the retreat of the ice sheet. At first they were a series of separate water bodies draining south into the Mississippi. Later they drained through the Mohawk Valley to the Hudson and finally through the St Lawrence Valley to the Atlantic. Niagara Falls, between Lakes Erie and Ontario, formed where a resistant bed of hard limestone cuts across the valley of the Niagara River as a cuesta upland ridge.

(*d*) *The Arctic Slope* (Number 10, Figure 58) consists of two large areas of clayey soil sloping gently to the Arctic Ocean and Hudson Bay (see Figure 58). They are significant because they represent areas of soil in an otherwise generally soil-less region.

(*e*) *The Yukon Lowlands* (Number 11, Figure 58) occupy the greater part of central Alaska and consist of the flood plain of the lower Yukon River. Because of poor soil drainage and soil freezing in many parts, they offer only limited opportunities for agricultural development.

**7. Drainage.** The greater part of North America is drained either north to the Arctic Sea, south to the Gulf of Mexico or east to the Atlantic. Its great rivers are the Yukon, Mackenzie, Coppermine and Nelson-Saskatchewan draining northwards; the Great Lakes-St Lawrence system draining eastwards; and the Mississippi-Missouri and Rio Grande draining to the Gulf of Mexico. Apart from these the Fraser, Columbia and Sacramento-San Joaquin drain westwards to the Pacific while the Colorado drains south-west into the Gulf of California. Because of the closeness of the Appalachians to the coastline the east coast plain is crossed by numerous short but important rivers, among which may be noted the Hudson, Delaware, Susquehanna, Potomac and James.

The level and low-lying nature of the interior lowlands enables most of the larger rivers to be navigated for long distances. There are over 10,000 miles of navigable waterways, and they were of great importance in the opening up and development of the inland. Today they form a vast network of waterways that are a vital factor in the economic development of the country. The Great Lakes-St Lawrence waterway is one of the world's greatest, and the Lake Superior, Michigan, Huron and Erie section has been of outstanding significance in the development of the great iron and steel industry of the United States. This will be discussed later when dealing with manufacturing areas.

In the western half of the continent the snow-fed streams of the Rocky Mountain area have been widely used to develop irrigation schemes, until today the United States is second to India in its development of irrigated works.

## EXERCISES

1. **Vocabulary words and phrases:** ria, névé field, truncated spurs, lateral moraine, ground moraine, medial moraine, terminal moraine, arêtes, cirques, hanging valleys, skerry guard, lake-filled plain, monadnock, air drainage, cuesta.

2. Describe the important results of glaciation in North America.

3. Contrast the physiography of the western and eastern sections of the United States as divided by the meridian of longitude 100° W.

4. Write an account of the physical geography of *either* the Basin and Range Province of the Western Highlands *or* New England.

5. Draw a large map of eastern North America from Labrador to Florida. Shade in the highlands and show clearly the outlets through the St Lawrence Valley and the Hudson-Mohawk valley. Insert the Fall Line and the cold and warm ocean currents. Describe the interesting features of this map.

# CHAPTER XXI

# COMPARISON OF PHYSICAL FEATURES, SOUTH AND NORTH AMERICA

Before making this particular comparison let us study some of the general characteristics of continents, which in part rise because they are huge land masses.

## The Pattern of Continents

Take a globe and study the relative position of the continents on it while rotating it with the Equator at your eye-level. You will notice two main facts:

(*a*) That the greater part of the land lies north of the Equator;

(*b*) that the general arrangement of the continental land masses is along north to south lines rather than from east to west.

Now turn the globe so that you look in turn on the North and South Poles while rotating it. The grouping of the continents north of the Equator will be even more noticeable; and you will be able to appreciate what geographers mean when they call the northern hemisphere the "Land Hemisphere" and the southern hemisphere the "Water Hemisphere". Actually the water occupies 71 per cent of the total surface area of the globe and the land a mere 29 per cent (or 57½ million square miles out of 196 million); yet this 29 per cent is very important, for there we find mankind striving with Nature for a living.

Take the globe and again hold it so that you are looking down on the North Pole. At the same time imagine you have cut the surface with a knife down through the Atlantic and Pacific oceans, then peeled off the outer covering and laid it flat on a table. You would then see a plan something like that in Figure 67(a). In it the continents are arranged propeller fashion, so that Asia, Europe and North America surround the Arctic Ocean as an almost continuous land area to represent the boss of the propeller. From here the three peninsulas of South America, Africa and Malaya-Australasia extend southwards as the propeller blades. This pattern is referred to as the *Tri-peninsular Continental Plan* (see Figure 67(b)), and it is very necessary that you become familiar with it, especially when dealing with dispersion of peoples, animals and plants over the surface of the earth.

By looking at the globe with the South Pole in the middle, and imagining a similar cutting and flattening, it will be seen that Antarctica now forms a centre surrounded by a continuous water body from which

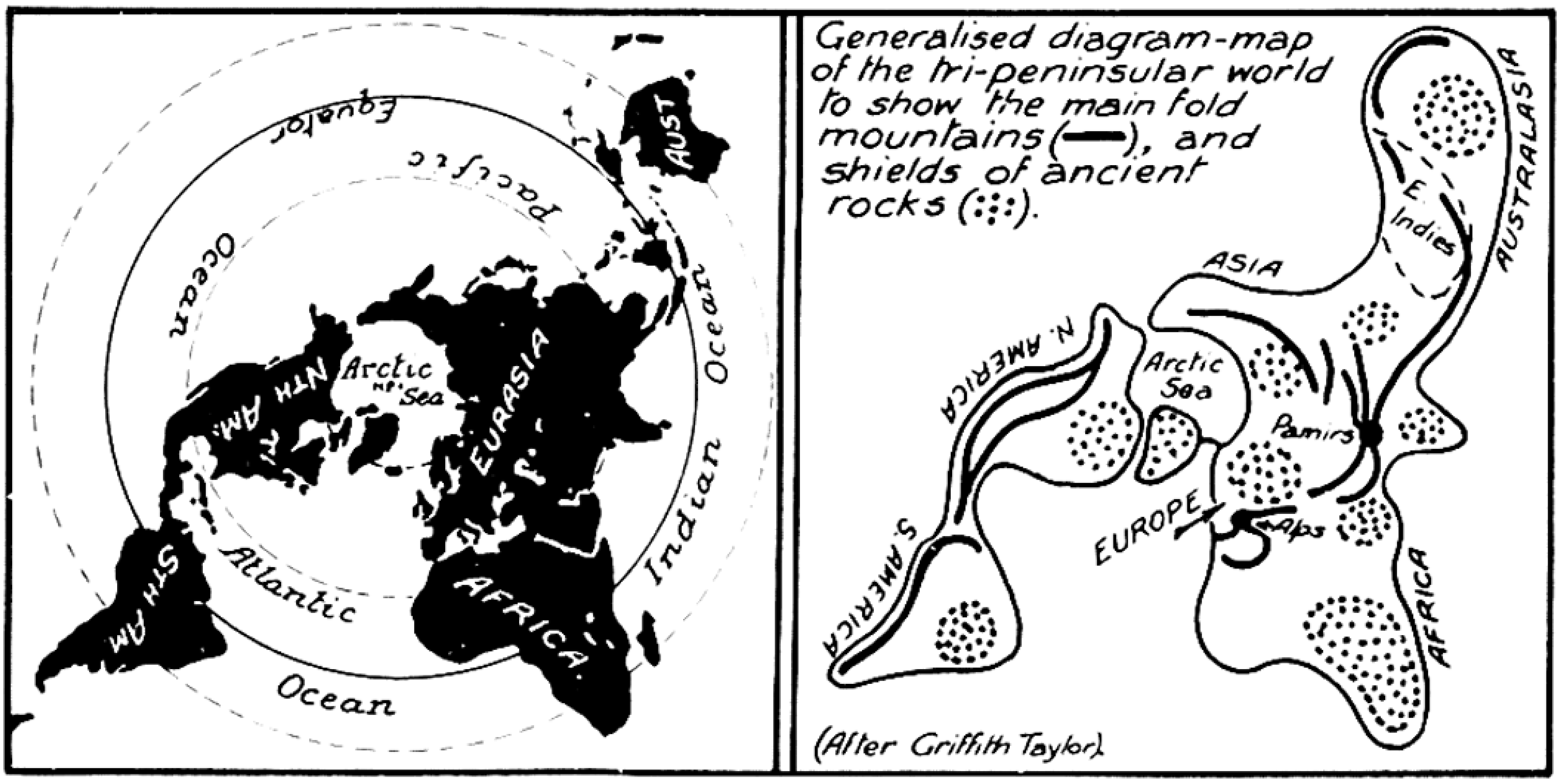


FIG. 67. *Diagram maps to show the tri-peninsular world.*

the Pacific, Indian and Atlantic oceans extend northwards between the land peninsulas. There is thus a definite antipodal arrangement of land and water, with Antarctica opposite the Arctic Sea and each of the continental masses opposite one of the large oceans.

## Continentality

Because of the fact that they are large land masses, all continents have certain common geographical factors, and it is this property that makes it possible to study the geography of the world on a generalised basis and to obtain world patterns for all the major geographical factors, such as landforms, climate, soils, vegetation and human occupations.

**1. Composition.** All are composed of mountains, plateaux and plains, the different continental patterns being due to varying proportions and different arrangements of these landforms in each continent.

The mountains may be parallel to or at right angles to the major coastline (which is regarded as being the coast from which weather changes move inland). If concordant (i.e., parallel to the coast) they block rain winds, and cause rain-shadow areas inland as in the Basin and Range Province of western North America. Such ranges also make communication from the coast to the inland difficult unless cut by transverse valleys as are the Appalachians.

The arrangement of plains and plateaux in relation to the coastlands is also important, since plains extending from the coast inland, as do the central plains of North America, the Pampas of Argentina or the Great European Plain, permit economic development as well as allowing rain-bearing winds to penetrate well in towards the heart of the continent. Plateau scarps close to the coast, as in Africa, act as barriers to exploita-

tion of inland regions and tend to emphasise greatly the importance of river valleys that break through such scarps (as do the Niger and Zambesi in Africa).

2. **The rock structure** and geological patterns also show similarities, since all continents are composed of groupings of the three principal rock types: igneous, sedimentary and metamorphic.

(*a*) *Igneous rocks* are those which have formed by the cooling of molten rock material. They are usually crystalline and have many chemical components. Some common ones are granites, syenite, diorite, dolerite, porphyries and basalts.

(*b*) *Sedimentary rocks* are those which have been laid down as sediments by the action of winds, water and ice. They are usually stratified and are composed of particles obtained by the breaking down of other rocks. Some common ones are conglomerates, glacial till, sandstones, limestones, shales and mudstones.

(*c*) *Metamorphic rocks* are those formed by pressure and heating or impregnation with waters charged with minerals. They may be derived from either sedimentary or igneous rocks and are usually hard and resistant to erosion.

In the continental patterns we often find great areas of old metamorphic rocks forming the core or shield round which the continent has been built. Such was the case with the Laurentian shield in Canada, the Western Australian shield or the Baltic shield in Europe. Huge granite masses form the cores of many of the younger fold mountains and apparently performed the same function for older mountains, for we find granite areas exposed after the removal of the overlying folded material in many older areas of earth folding. It is one of the basal rocks of large areas of most continents.

The sedimentary rocks of later geological times have been deposited about the cores of ancient metamorphic rocks and the granites, with those of the very recent periods forming the alluvial plains and deltas along the continental margins. Sometimes these river sediments have been buckled and folded against the almost immovable core; and sometimes they have been intruded by sills or overlain with lava flows as in the Columbia Plateau.

3. **General climatic similarities** ot the continents makes possible the determination of climatic types, for there is a general repetition of climatic features in similar latitudes and similar continental positions. The isohyet maps show that rainfall belts are zoned with the heavier amounts on the coastline or along the Equator, and with decreasing amounts towards the continental interiors.

*Temperatures* also show variation between the interior regions, with hot summers and cold winters (the typical continental climate), and coastal margins with more uniform temperatures (the maritime climate).

The interiors of all continents are characterised by anticyclones,

associated with continental air masses, while the coastal margins experience a far greater number of cyclonic storms and violent weather changes from association with the various maritime air masses.

4. **Vegetation** depends primarily on climate and therefore shows a similar zoning to rainfall. All continents have examples of the major vegetation types of forest, woodlands, grasslands, scrublands and desert forms. The arrangement and proportion of these within the continent are dependent on the general climatic and landform features.

5. **Opportunities for economic development** will tend to correlate with the physiography, climate, soils and vegetation. The actual development will depend primarily on the stage of technological development of the people inhabiting the continent. Thus tropical Africa and South America tend to be more backward than Europe or North America because the native inhabitants of the Congo or the Amazon are at a very low level of technological development.

### Similarities between North and South America

The two maps in Figure 68 emphasise some of the more obvious points of similarity from among those listed below:

(*a*) Both continents are triangular in shape, with the apex in the south and the base in the north. Note, however, that this means that the bulk

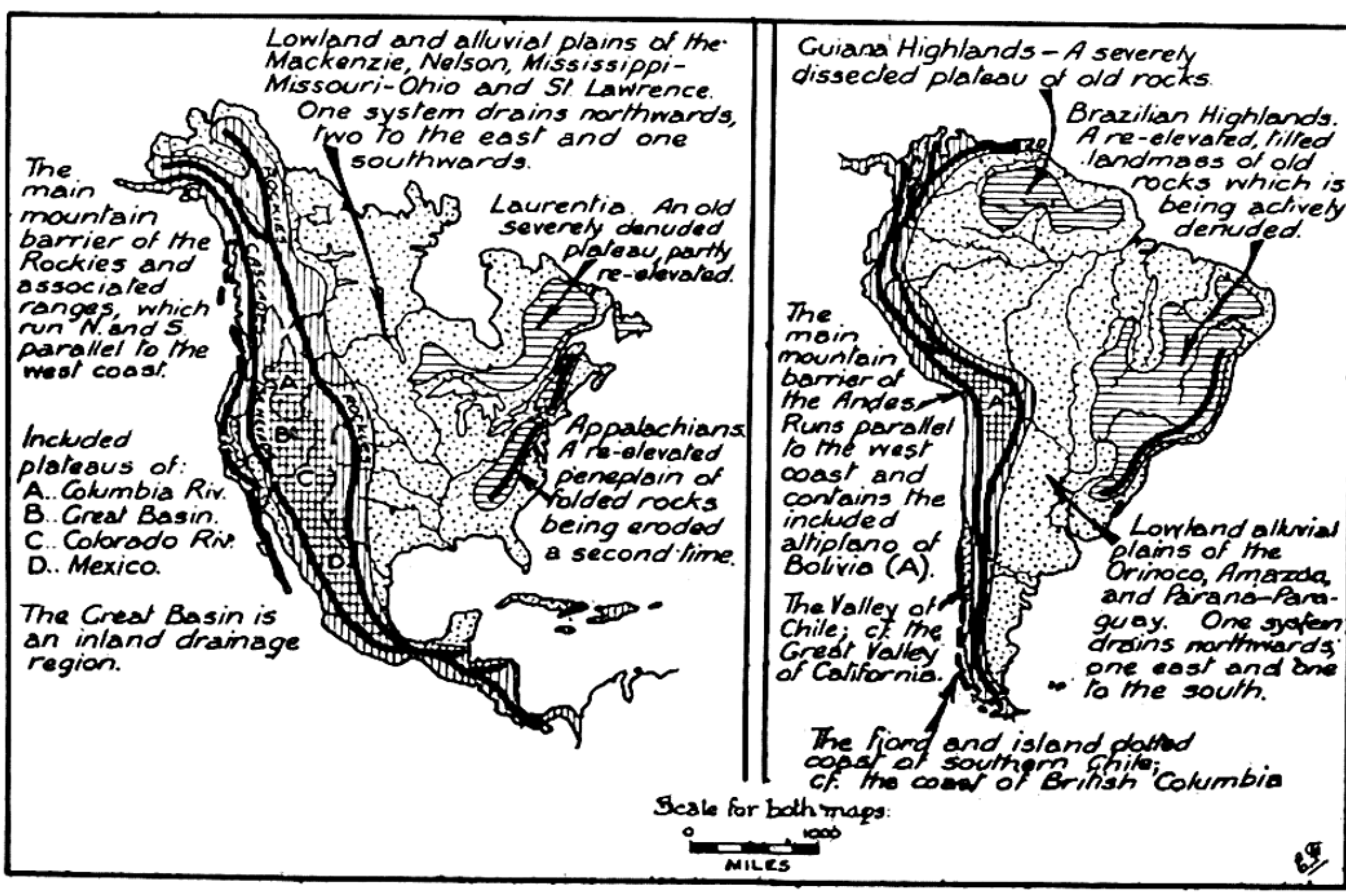


FIG. 68. *Generalised maps comparing the physiography of North and South America.*

of the South American land mass is tropical, while the North American continent is in the middle and polar latitudes.

(*b*) The arrangement of the major landforms is remarkably alike, with each having a mountain region on the west, a lowland in the centre and areas of plateau and highland on the north east (Laurentian and Guiana highlands), and south-east (Appalachians and Brazilian highlands).

(*c*) The drainage patterns are generally similar, the Mississippi system pairing with the Parana-Paraguay, the St Lawrence with the Amazon, the Mackenzie with the Orinoco and the Yukon with the Magdalena-Cauca.

(*d*) The western mountains in each case consist of several parallel chains with included plateaux and basins between them. Here the Andes are much more striking than the Rockies, but the included plateaux and basins of the Rockies are much more impressive than the Altiplano of Bolivia and the mountain basins of Peru and Ecuador.

(*e*) Further similarities in the mountains and basins may be noted between the Valley of Chile and the Valley of California, both of which are enclosed between a low coastal range and the main mountain barrier farther inland.

(*f*) Again, in both cases these included valleys of the western coast continue polewards as drowned valleys flanked by island chains on the seaward side and heavily fiorded coasts on the landward side.

(*g*) In both cases the eastern systems of highlands are partly concordant, but mainly discordant with the nearby coastlines.

(*h*) The plateau areas on the east are mostly composed of much older rocks than those of the western mountains. Where earth movement has occurred in these eastern highlands it has formed block mountains rather than fold mountains.

(*i*) More similarities will be noted when studying the climate, soils, vegetation, minerals and human occupations in each of the continents.

(*j*) Finally, it is necessary to note differences in the general levels of technological development and utilisation of resources. Here we may see the way in which different peoples make use of similar environments.

# CHAPTER XXII

# FORMATION OF LANDFORMS IN HUMID CLIMATES

## Survey of Forces at Work

The major landform features of the continental areas of the earth's surface are mountains, plateaux and plains. Of these, mountains like the Alps, Rockies, Andes or Himalayas, and plateaux such as the Brazilian, African, Arabian or Mongolian, have been formed by the fracturing, buckling and uplifting of huge areas of the earth's crust. The plains are mainly the result of the filling in of large hollows in the surface with material obtained by the wearing down of high ground. The present surface appearance of the highland areas, with its complicated patterns of ridge and valley, mesa and canyon, craggy peak or rounded hill is essentially the result of *denudation.*

Denudation is the constant attack on the solid earth by the atmosphere and surface waters. This attack is partly chemical, but mainly mechanical, and is animated principally by the force of gravity.

On exposure to the atmosphere, rocks are subject to a constant attack by the heat of the sun, the cold of night frosts and the steady gnawing of percolating waters, which eat away many rock-forming minerals because of the minute amount of carbon dioxide dissolved in them. This attack and the subsequent steady disintegration of exposed rock surfaces is known as *weathering.* If this were the only thing happening, the rocks would soon be buried under, and hence protected by, the mantle of weathered material. On land the surface is mainly sloping (and this is particularly the case in upland areas) and the weathered material slides downhill—a process that is greatly aided by rainwater. Ultimately, much of the loose material gets washed into streams and rivers, which carry it and dump it finally along their lower courses as flood plains, in lakes, or into the sea, where the currents, tides and waves spread it along the off-shore sea bottom. Thus *transportation* and *deposition* of the weathered material complete the story of denudation. Wind and moving ice also help remove the products of weathering in certain limited areas. In addition, all three agents—wind, ice and water—use the transported material to wear away the land as they pass over it. This general destruction by moving agencies is called *erosion.* The whole process of weathering, denudation and erosion proceeds most rapidly on higher ground and steep slopes. It therefore works to reduce the earth's relief until it reaches a general level little above sea-level. Such a low, worn-down surface is known as a *peneplain.* Since the earth is of great age and has been sub-

jected to the forces of denudation during its whole existence as a solid globe, the present highland areas can only be explained by assuming a fairly recent uplift of those parts of the surface. Geological evidence here shows that there have been several periods in which uplift occurred and that each of these has been followed by long periods of denudation, when the whole of the land surface of the earth was again reduced to a peneplain. At the present time the earth is commencing a period of denudation after the close of an era of uplift which has, in fact, not really finished on all parts of its surface.

The tectonic forces and the mountain building coming from their action will be dealt with in Volume IV under "The Alps". Here we will examine the work of the forces of denudation, especially in humid areas, just as those in arid lands were discussed under the general heading of "Deserts" in Chapter II, Section 4, "Climatic Types".

### The Major Landform Forces

We may note the following four phases in landform formation:

(*a*) *Weathering* is the attack on the rocks by the agents of the atmosphere and results in their breaking up.

(*b*) *Transport* covers the removal of the debris formed by the action of weathering.

(*c*) *Erosion* is the active wearing away of the land surfaces by various moving agencies, of which rivers and ice are the most significant.

(*d*) *Deposition* covers the dumping and spreading of the materials obtained by land destruction in sheltered locations to build new rocks and landforms.

All these phases are going on together with destruction, which is the dominant one on higher areas. Variations in the rate of denudation depend on differing hardnesses and disposition of rocks, differing climates and differing land slopes.

**1. Weathering** can be divided into chemical and mechanical, chemical being concerned with the dissolving and removal of mineral constituents of rocks, while mechanical embraces the breaking up of the rock into smaller particles through the agency of heat, cold or water. The effect of heat was noted in the section on deserts, but it also operates on exposed rock surfaces in high altitudes, where the great changes in temperature between day and night cause exfoliation of many rocks.

Much more potent than mere temperature changes is the action of freezing water. All rocks contain minute pores, cracks and fissures and rain water penetrates into such cracks. If it freezes, as it will do in high altitudes where day temperatures are warm enough to melt some snow and night temperatures fall below freezing point, then it expands by one-ninth of its volume. The continued thawing and freezing of the percolating water

acts as a wedge, and finally breaks off slabs of rock which fall and accumulate as *screes* of loose rock material along the foot of steep slopes. The frost action then continues on the blocks forming the screes, gradually breaking them up into small fragments. This frost action is the main factor in producing the steep cliffs, knife-edge ridges and sharp pinnacles in high mountain areas (see Figures 60 and 62).

The chemical processes of weathering are more complex and are of greater total importance than mechanical weathering. They require the presence of water and are most effective at high temperatures. This means that they operate over all land surfaces with warm humid climates. In brief, chemical weathering consists of the dissolving out from the rocks of certain minerals susceptible to attack by rain water in which are dissolved small amounts of carbon dioxide and humic acids from plant remains. The weak acid solution so formed eats into the rock structure like a cancer. For example, granite is composed of mixed crystals of quartz, felspar and mica. In its fresh state it is very compact, hard rock, but its weakness lies in the felspar and mica crystals. Both of these are readily attacked by the percolating rain water to form clay and soluble salts which are steadily washed away. After a long period of time the originally solid granite is converted into a crumbling mass of sand and clay.

All other igneous rocks are attacked in a similar fashion and reduced to loosely knitted material which is removed easily by the forces of erosion. Sedimentary rocks are less liable to chemical weathering, for they are mostly built up of the insoluble residues from igneous rocks. However, limestone is particularly susceptible, and in certain sedimentary rocks the cementing material is lime or iron salts, both of which may be attacked and removed by percolating waters.

**2. Transport, Erosion, and Deposition.** The general effects of ice and wind have been noted in previous sections of this book. Their action is rather limited in extent, and over most of the earth today running water is the most important agency engaged in moving the weathered material and in using it as a tool to carve out the land over which the water flows.

The rain run-off on steep slopes carries or pushes along great quantities of earth and rock material. This is called the load of the stream and its size and quantity depend directly on the volume and speed of the stream. Speed of flow is the most important factor here, and it has been shown that the river's transporting power is proportional to between the 3rd and 6th powers of its velocity. As the speed of a river often trebles or quadruples during flood periods, the consequent increase in transporting power (and this includes pushing of rocks as well as carrying finer material) is very great indeed. For example suppose a stream flowing at two miles per hour could bowl pebbles up to two inches in diameter. If the speed of this stream increased in a big flood to eight miles an hour, the stones it could roll along would now be up to sixty-four inches in diameter.

Most of the work of erosion by streams is done by these rock fragments

that the river carries and bangs against the sides and bottom of its valley. In this process the pebbles are ground ever smaller, but they also abrade the valley walls gradually to widen and deepen it.

Where the current slackens the process lessens and finally ceases. Here the river spreads its material over the valley floor or out into the sea to build up alluvial lowlands and deltas.

The rate of erosion and deposition depends on many factors and is always greatest in rivers with steeply sloping basins. In each river basin the rate of erosion is much faster over the upper courses than in the middle or lower courses, and this results in a variety of landscape sculpture within river basins, which gives each part of the basin distinctive physical characteristics.

## River Valleys

In a normal well-developed river there are at least three different types of valleys developed.

**1. The upper or youthful section.** Most rivers start with a converging group of small streamlets or in a swamp or marsh or maybe a small lake set in a high pocket of the hills. From this collecting area the river cuts a steep-sided V-shaped valley down the nearby slope. The stream is here engaged in rapid downward erosion. Abundant rock waste aids the swiftly flowing water to abrade the valley bottom. Potholes are formed where the stream eddies and swirls round bends and uses the pebbles in a kind of gimlet action to cut into the bed of the stream. In this section there are many irregularities in the bed mainly because of ledges of hard rock cutting across it. In plan such valleys are generally somewhat sinuous, and viewed uphill from downstream, the deeply incised trench swings about with the stream hidden behind overlapping spurs (see Figure 69).

As we proceed downstream the river grows in volume and its valley deepens. At the same time the gradient of the bed slackens and the current becomes less swift. In many places where mountain streams enter a main river the change in gradient at the point of entry is very abrupt and much of the material transported by the main stream is dumped as an *alluvial fan.*

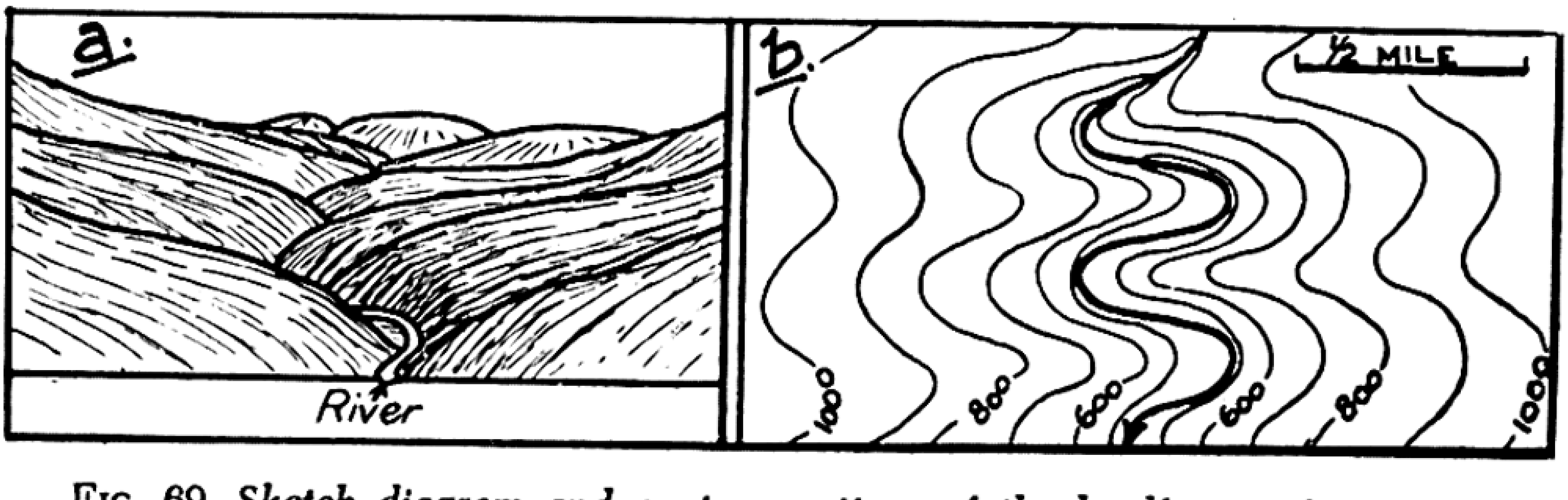


FIG. 69. *Sketch diagram and contour pattern of the landforms of a young river valley.*

**2. The lower or mature section.** With the reduced gradient the river is unable to erode its bed so rapidly, and it now starts to cut away its valley sides to change the cross profile from a V-shape to a U-shape. In addition, on the slack water side at the bends, the stream tends to deposit

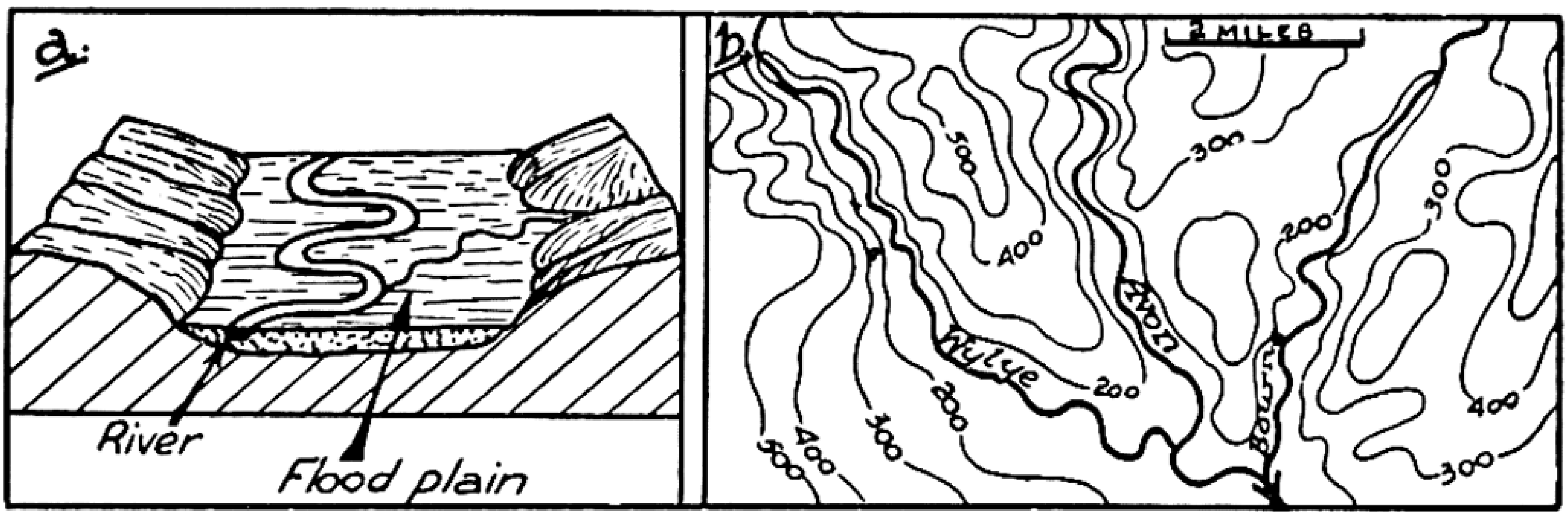


FIG. 70. *Sketch diagram and contour map of a mature river valley.*

material to form a small flood plain. In time the valley will widen considerably and the flats will appear on each side of the stream, which now meanders over these flood plains with the backing hills at some distance from it (see Figure 70). This mature portion is known as the *valley tract.*

**3. Plain tract (old) section.** Farther downstream again, the valley tract gradually merges into the third section, known as the plain tract of the river's course. Here the valley sides retreat to a great distance from the stream channel and the general topography of the whole area becomes subdued, with very gentle slopes on the few hills remaining to break the level surface of the flood plain. The stream itself is now sluggish and flows over a built-up bed of its own creation. It follows a meandering course, and during floods it often takes a short cut across the narrow neck

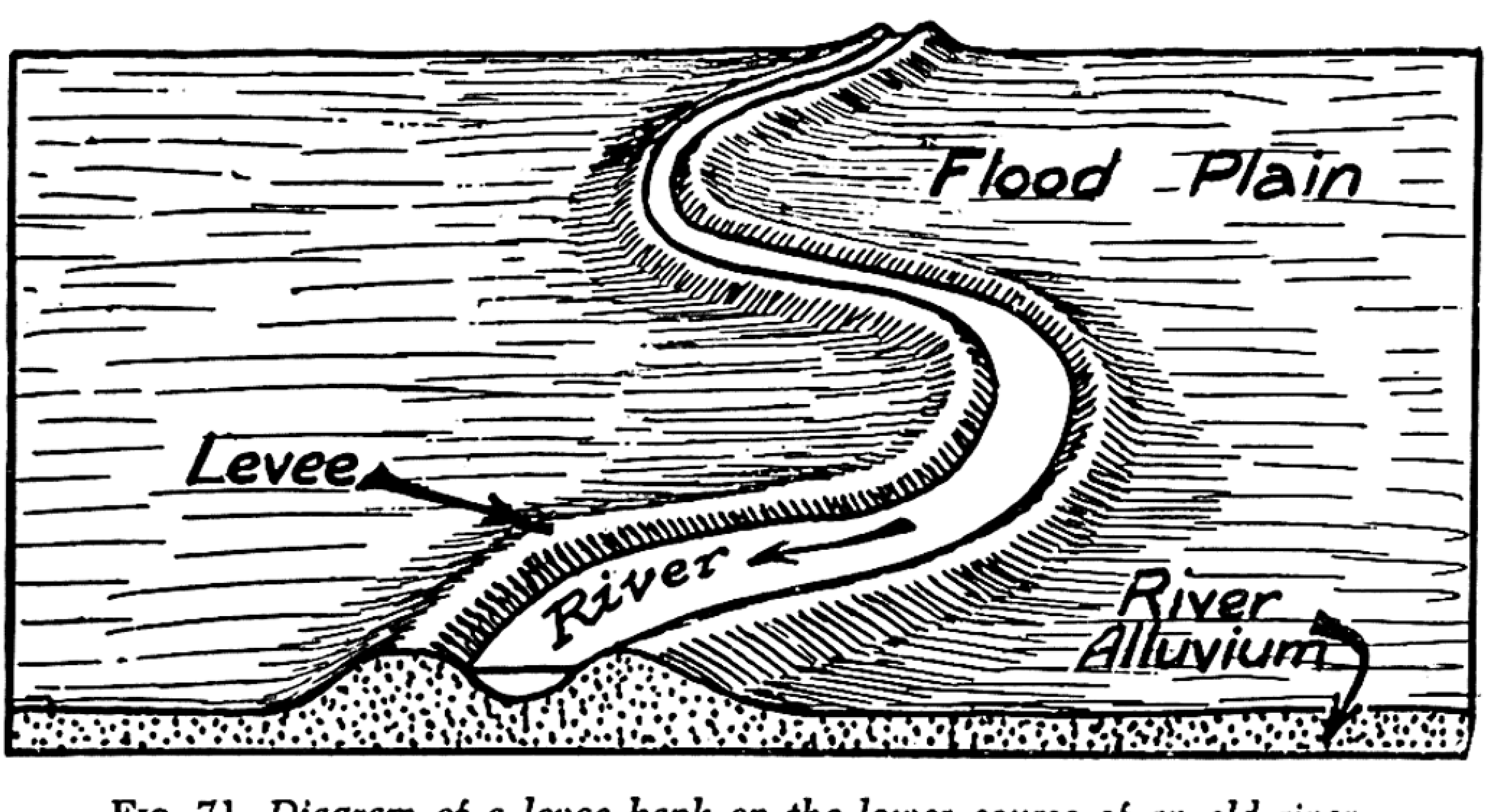


FIG. 71. *Diagram of a levee bank on the lower course of an old river.*

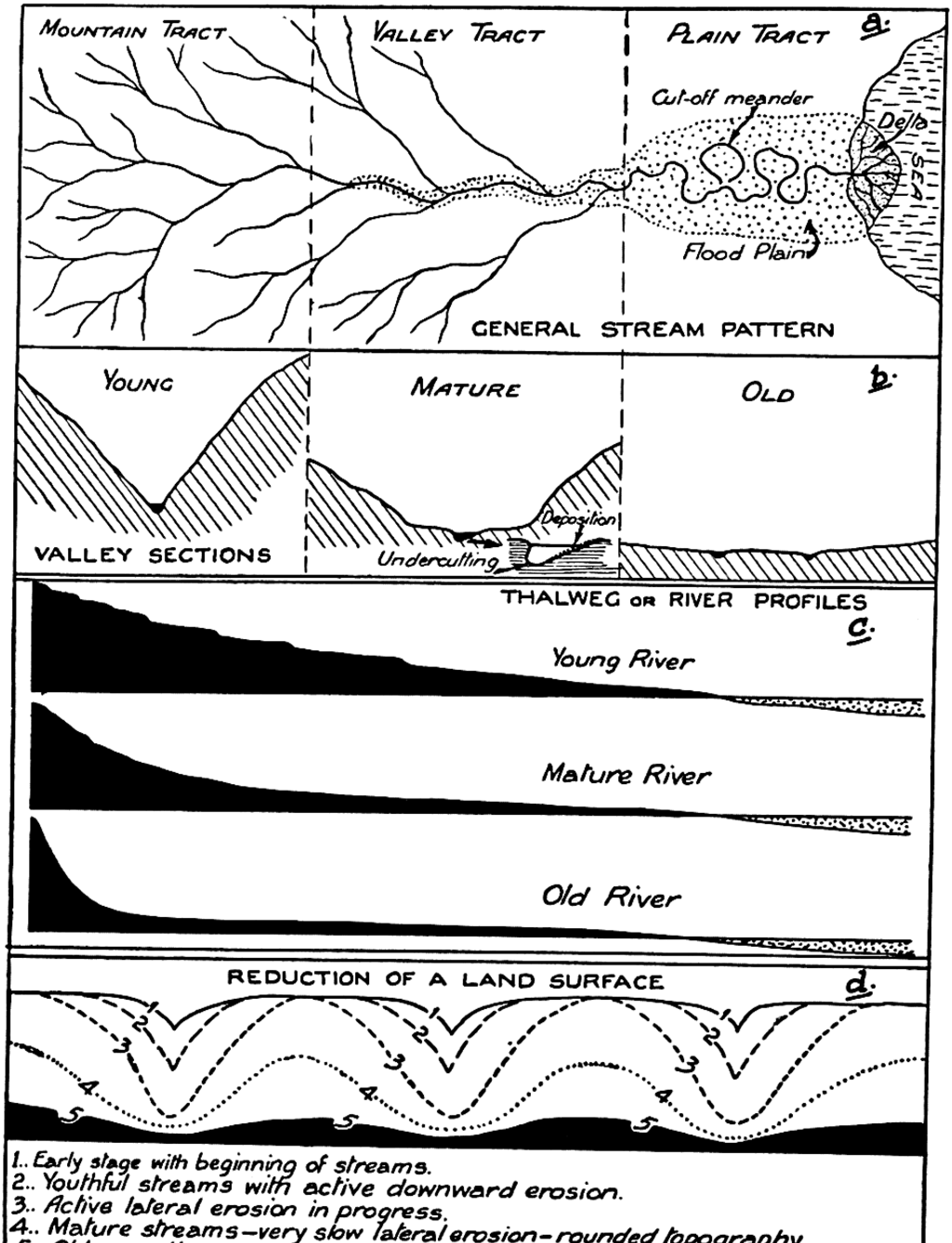


FIG. 72. *Diagram summaries of some important features of river valleys and river systems.*

of a meander to cut off the loop entirely. In such cut-off portions, ox-bow lakes, billabongs or cut-off meanders are left to fill up slowly with silt and marsh vegetation. In succeeding floods the stream may return to these old channels.

In the flood plain tract the river is working very slowly and the emphasis has shifted from erosion to deposition. Sea-level fixes the limit of river erosion since water can only flow and cut down-hill. As the speed of river flow drops in crossing the flood plain, the deposition of suspended material may become so great as to raise the bed above the general level of the surrounding country, and the stream flows in a channel confined by *levees* built by itself (see Figure 71). On reaching the sea, many rivers have extended their flood plain beyond the original coastline to form *deltas.* On reaching the still water of the sea (or a lake) the river flow is checked and its load of sand and mud is dropped. The coarser materials settle first and the finer mud is carried farther out before settling to the sea bottom. Deltas grow in various shapes and not all have the almost perfect triangular shape of the Nile Delta. The Mississippi flood plain and the Indo-Gangetic plain are examples of vast deltas filling in an ancient arm of the sea to form extensive alluvial lowlands.

In describing a river as a whole, the terms young river, mature river or old river are used according to which one is the dominant form throughout the course. Thus, the Murray is an old river because at least 70 per cent of its valley is old; the Hunter is a mature river; and the Colo a young river.

Figure 72 is a series of annotated diagrams showing some features and sections of various types of valleys. Figure 72(a) shows the pattern of tributaries and the formation of a flood plain in a typical river. Figure 72(b) shows cross sections of the three main types of valleys. Note the small inset in the mature valley section to show the undercutting of one bank and the deposition on the other.

In Figure 72(c) the sections from source to mouth of each of the three river types are drawn. Such a section is called a *Thalweg* (plural, *Thalwege*). Figure 72(d) is a series of superimposed cross sections to indicate the long-term erosion of an upland area to a peneplain.

## EXERCISES

1. **Vocabulary words and phrases:** denudation, weathering, erosion, tectonic forces, screes, alluvial fan, valley tract, mountain tract, plain tract, young river (or topography), mature river (or topography), old river (or topography), thalweg, levees.

2. How does a normal river system develop from youth to old age? Illustrate with examples.

3. Explain the operation of running water, winds and changes of temperature as agents of denudation.

4. Choose three important agents of erosion and with the aid of diagrams show how each wears away the land.

5. Compare carefully the physical features of a mature river valley and a glacial valley.

# CHAPTER XXIII

# CLIMATE OF NORTH AMERICA

## General Features

Figure 73 summarises some of the more important landforms and air masses affecting the weather and climate of North America.

**Landforms.** The general north-south trend of the Rockies and Appalachians creates a broad channel through the centre of the continent, while the St Lawrence Valley gives an exit from this channel to the east. The major climatic barrier of the Rockies prevents most Pacific weather from reaching the interior and acts as an orographical barrier to rains moving into the included Basin and Range area. The minor climatic barrier of the Sierra Nevada forms another orographical barrier to rains moving in from the Pacific to the included plateaux and basins. Hence the Basin and Range Province is a "double rain-shadow" area.

The parallel arrangement of the main highlands tends to channel (or canalise) the tropical and arctic weather storms up and down through the central lowlands, and often out to the east via the St Lawrence Valley. Thus the warm tropical air reaches the Arctic Circle in summer and the cold polar air often reaches the Gulf of Mexico in winter. The map also shows the principal air masses affecting the climate of North America. Before studying them we will examine air masses generally.

## Air Masses and Fronts

**1. Air masses.** In the sections on African climate (Chapter II) we saw something of the general spread of pressure belts over the world and the atmospheric circulation consequent on their distribution. It now becomes necessary to note that both the pressure areas and the wind belts are merely averages of what are really great, irregularly moving masses of homogeneous air associated with travelling high- and low-pressure centres, called anticyclones and cyclones respectively.

These air bodies are known as air masses. An air mass therefore is a very large part of the lower atmosphere (up to 10,000 feet in depth) which has fairly uniform temperature and moisture conditions. Stationary air masses develop wherever the atmosphere remains in contact with an extensive, uniform surface for a period long enough for the air to acquire the general properties of temperature and moisture of the surface on which it rests.

Those areas where air masses develop are called *source regions*, and the most significant of them are (*i*) the polar anticyclone areas; (*ii*) the anticyclone areas of the sub-tropical latitudes; and (*iii*) the tropical and mid-

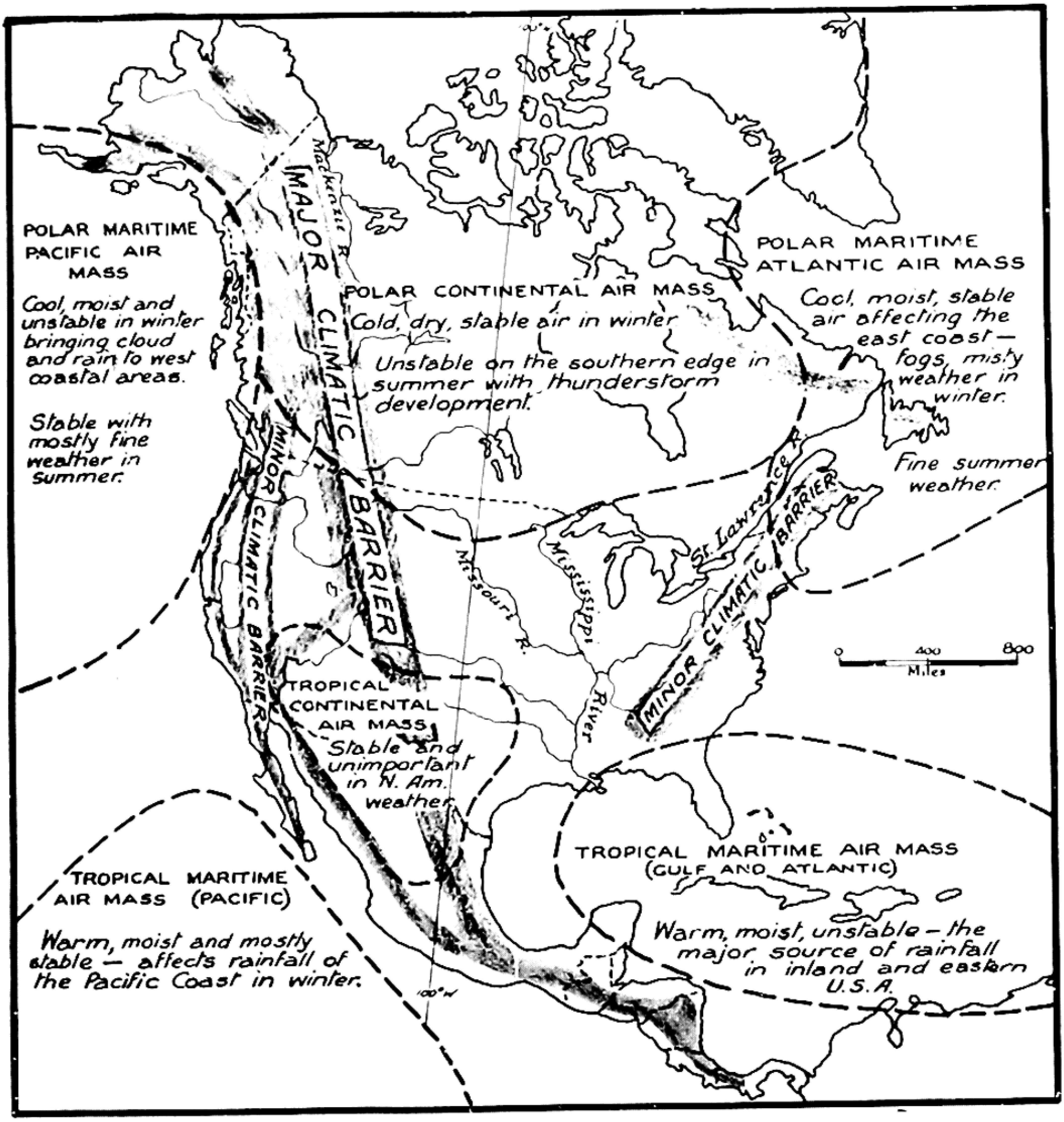


FIG. 73. *Principal landform features and air masses affecting the climatic geography of North America.*

latitude oceans. The continental lowlands of Canada and Siberia and the deserts of Sahara and Australia are also important source areas. In general the principal source regions are in areas of high latitude and low latitude, as both have large areas of relatively uniform surface conditions. As the characteristics of air masses depend on the earth's surface below them, we may note four main groups:

1. Polar: cold and heavy air;
2. Tropical: warm and light air;
3. Marine: wet air;
4. Continental: dry air.

We may picture the lower atmosphere as a mosaic of different bodies of air of which some are stationary, while others bud off and move away from the stationary ones as cyclones and anticyclones.

**2. Fronts.** The air of one air mass does not mix readily with that of another, and the boundary surface between two air masses is called a front. In general, warm air overrides cold air and the sharpness of any front depends largely on the difference in temperature between the two impinging air masses. Fronts are areas of turbulence and disturbance, where squalls, cloud and rain are a feature of the weather.

The two major air masses affecting the eastern two-thirds of North America are the polar continental and the tropical maritime (see Figure 69). The front between these two air masses lies over the central lowlands in widely varying positions throughout the year. These middle latitudes may be looked on as the battleground of the air masses, with the actual battle front swinging north in summer and south in winter.

One of the most powerful factors affecting the weather of northern middle latitudes (roughly between 30° and 60°) is the periodic outburst of cold air from polar air masses normally lying over Greenland and the lowlands of Siberia and northern Canada. The polar continental air mass develops over these cold land areas under conditions of clear skies and an absence of winds. When it has attained sufficient volume, the air mass moves out from the centre of accumulation. This movement is a spilling out in all directions, like a drop of oil spreading over a water surface; but it is strongest in the direction towards the nearest area of low pressure, i.e., towards the tropical air mass. In North America its main line is down the central lowlands and out to the east through the St Lawrence Valley, or on south through the lower Mississippi Valley.

**3. The weather associated with an advancing polar air mass.** As the polar air bodies move south into the area of relatively warm air, they become separated from the source region. They then advance as a generally homogeneous body of air shaped something like a blob of oil running over an inclined surface—only the blob is over 1000 miles across and up to two miles deep. The front edge of this moving body of cold air is wedge-shaped and its generally heavy nature causes it to slide along the ground under the warmer air occupying the region. As this warm air meets the advancing mass of cold air, eddies are formed along the junction line. These develop into the cyclonic storms of middle latitudes. The advancing cold front lifts these eddies upwards in much the same manner as air currents are forced over a mountain range to give orographical rains—in fact, the general effect of the advancing air mass may be regarded as being much the same as that of a mountain range sliding across the country. The uplifting of the frontal eddies results in cloudy and rainy weather with strong shifting winds. In summer, when the warm tropical air is heavily charged with moisture, thunderstorms develop, while under occasional extreme heat and moisture conditions the frontal disturbance becomes a tornado.

This disturbed cyclonic weather continues at any centre for several days, by which time the advancing front has moved on and the cold air mass has been fully established over the area. The weather then becomes clear and warm with cool nights in summer and clear cold nights in winter.

This succession or alternation of warm humid air of tropical origin and cold clear air of polar origin provides the variable weather conditions characteristic of the middle latitudes.

Of the other air masses shown on Figure 73:

(*i*) The tropical continental is of little significance as the continental land area is here too small to allow for its full development. (*ii*) The polar maritime Pacific air mass and the polar maritime Atlantic air mass play little part in American weather other than bringing foggy and rainy conditions to the respective coastal areas. The rain on the Pacific Coast is greatly increased by the presence of high mountains close to the shoreline.

## Summary of Seasonal Climatic Conditions

Figure 74 contains a series of four maps on which are summarised the essential features of the North American summer and winter climates. We will note a few significant points:

**1. January (or winter conditions).**

(*a*) *Temperature.* As Figure 74(a) shows, the essential feature here is the amount of cold, both in actual low temperatures recorded and in the very large area with average readings below freezing point. Note how the 32°F. isotherm bends sharply south from the coast of British Columbia to a point close to the Mexican border and then runs eastward almost along the 40th parallel to leave the east coast at about the latitude of New York. In this great southward loop we see the result of the combined effect of high mountains and the expanding polar continental air mass over the inland plains. Only in the high plateau of Tibet and the Himalayas does the 32°F. isotherm approach as close to the Equator as it does in Arizona and New Mexico.

One very important result of this cold is the effect it has on farming routine. North of the 32°F. line the growth of winter crops of any kind is impossible, and all livestock must be hand fed during the long winter months. For this reason all types of animal farming throughout Canada and the northern two-thirds of the United States include the growing and storing of hay fodder crops. Another feature to notice is the great differences between the east and west coasts in the same latitude. Thus Sitka in Alaska, under the moderating influence of a warm ocean current, is never ice-bound and is 38°F. warmer than Hebron, Labrador, where icebergs may be seen even in midsummer. Vancouver has a January average of 36°F., while Montreal averages 14°F. and Halifax 24°F. This difference lessens southwards and disappears in the tropics.

The long and intensely cold winter closes all sea, lake- and river-ports north of the latitude of New York. On the Great Lakes the waterways are frozen for five months and all the movement of enormous quantities of iron ore, coal and wheat has to be crammed into seven hectic summer months.

(*b*) *Chinook winds.* During the winter period the foothill country immediately east of the Rockies experiences warm spells brought by the chinook winds. These are dry west winds blowing on the southern edge of depressions in high latitudes. The air in them obtains its warmth from

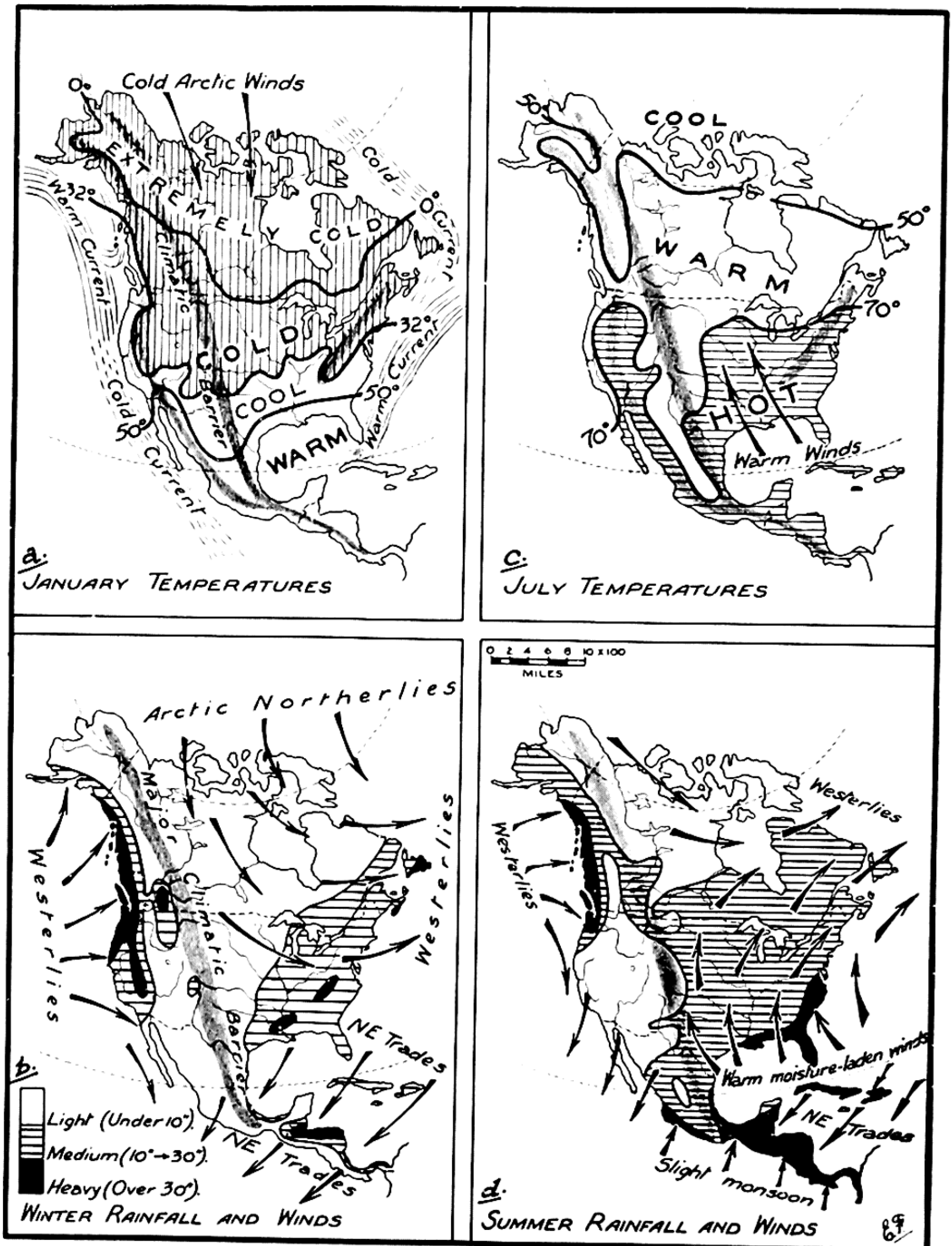


FIG. 74. *General summary of the seasonal climatic conditions of North America.*

the Pacific Ocean and loses its moisture in passing over the Rockies and associated mountains. (Study Figure 75 here to note both the arrangement of mountains and valleys and the rainfall variations due to a succession of orographical rains and rain-shadow areas). On its final descent from the Rockies to the High Plains it is sufficiently warm to melt the snows and make winter grazing possible in areas where it occurs. Dramatic rises in

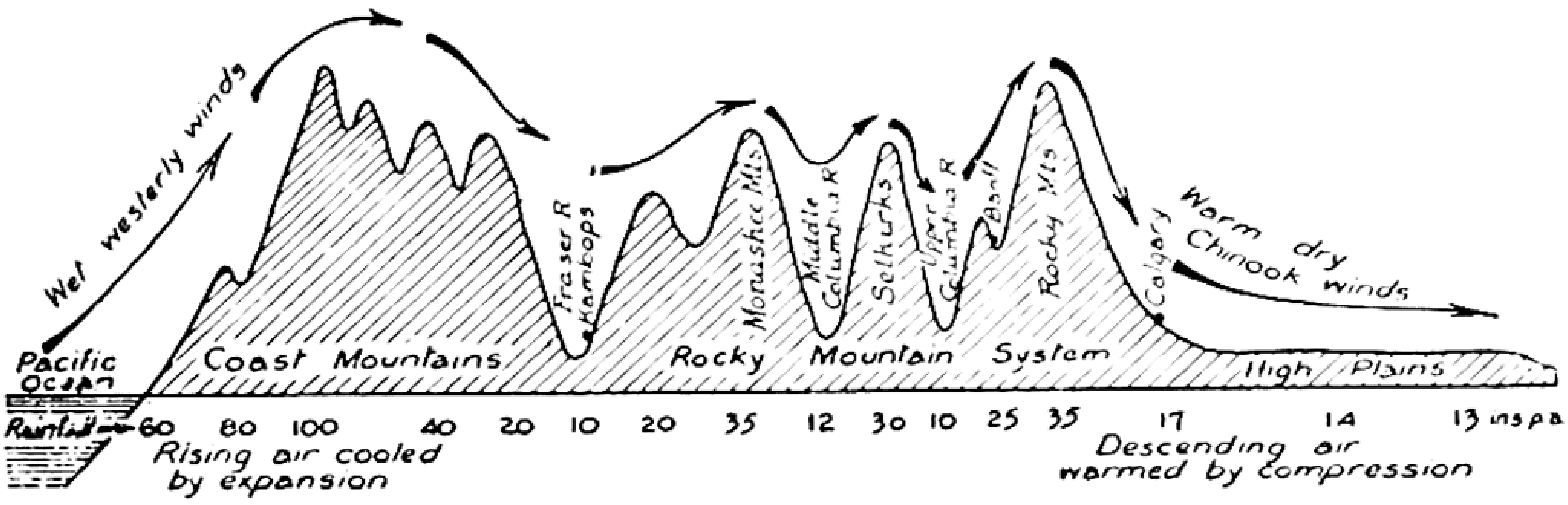


FIG. 75. *Section across the Canadian Rockies to illustrate the development of the chinook winds.*

actual temperatures accompany its arrival; as much as 40°F. in 15 minutes has been recorded, and although the top readings rarely exceed 50° this is warm by comparison with the intense cold elsewhere.

(*c*) *Winds and rainfall.* Figure 74(b), showing the winds and rainfall, reflects the remarks made in the section on air masses. The interior lowlands experience a flow of cold dry arctic air which is canalised between the two climatic barriers and which occasionally reaches the Gulf Coast as a devastating cold wave. On an average three or four cold waves reach the north-eastern States each winter season in front of the air stream passing to the east via the St Lawrence. The passage of cold waves down the lower Mississippi can have very damaging effects on the sub-tropical crops of the Gulf lowlands. As the result of these cold waves St Louis has recorded a temperature of -22° in January; in December 1831 the Mississippi was frozen for 130 miles below the mouth of the Ohio and ice on small streams and lakes at New Orleans was thick enough for skating. Early this century a temperature of 8° to 15° over much of Florida wiped out two-thirds of the orange orchards overnight. The winter precipitation is confined mainly to the west coast and eastern half of the United States. California receives its moderate rainfall during winter to give it a typically Mediterranean climate. Much of the precipitation elsewhere is in the form of snow. Notice that the snowfall throughout the Arctic and Canada is not heavy enough to give an equivalent 10 inches of rain. It is so light in many places that the strong blizzards blow it off open spaces to pile it in hollows and against logs.

**2. July (or summer) conditions.**

(*a*) *Temperature.* Figure 74(c). The most striking feature of the summer temperatures is the great loop of warm air reaching up through the central plains to within the Arctic Circle, with a second loop in the Yukon Basin. This warmth enables quick-maturing crops of vegetables to be grown at the mouth of the Mackenzie River. The growth of crops is also aided by the high insolation resulting from the almost continuous summer sunlight in these high latitudes.

Again, there is a marked difference in temperature between the east and west coasts. The west coast under the influence of an ocean current is now colder than the east coast, where warm air from the tropical maritime air mass flows out from over the land. Thus San Francisco has a July average of 59° as against 78° for Raleigh (N.C.) and Olympia (Wash.) has 63° in comparison with 72° for Boston.

The south-west now has very high temperatures as the desert summers reach their peak. 134°F. has been recorded in Death Valley, and readings of over 100° are common. Notice, however, the cooler loop on the Mexican Plateau, where the 70° isotherm dips south to 20° latitude.

The Gulf Coast and West Indies have very unpleasant hot (over 75° average) and humid summers and would be unbearable except for the cooling effect of the fresh north-east trade winds.

(*b*) *Rainfall.* Under the influence of the tropical marine air masses the whole eastern half of the continent receives sufficient to abundant rainfall. Very heavy amounts occur in Central America and south-east United States, while the coast of British Columbia again gets heavy rains from the on-shore westerlies being forced over the coastal ranges.

Marked rain-shadow areas occur in the Basin and Range Province while south-west United States, under the influence of the small tropical continental air mass, with its outpouring dry winds, is practically rainless.

### Annual Rainfall and Season of Rain

In the two maps on Figure 76 we see a summary of the seasonal rain maps in Figure 74. Several points are worth noting:

(*a*) The generally heavy rain of Central America. As the graphs on Figure 77 show, much of this is the uniform rainfall characteristic of the equatorial rain-forest areas. A second patch of very heavy rainfall occurs along the west coast of Canada, where orographical rains from the on-shore westerlies create a very damp climate.

(*b*) All the eastern half of the United States (together with south-east Canada) has a rainfall of over 20 inches, much of it over 40 inches. This is sufficient (or even abundant) for all forms of agriculture suited to these latitudes. When we consider that much of this climatically favoured area is also a fertile lowland, we may appreciate how fortunate the United States is in natural farming resources when compared with Australia or South Africa.

(*c*) The hot arid areas are limited to south-west United States and the Mexican Plateau and actually form quite a small percentage of the total area. Again the United States is favoured by comparison with Africa or Australia.

(*d*) Much of the Arctic is a cold desert, for it receives rain (and snow) amounting to less than 10 inches a year. Even with the small evaporation of these latitudes this total is too low to grow much vegetation.

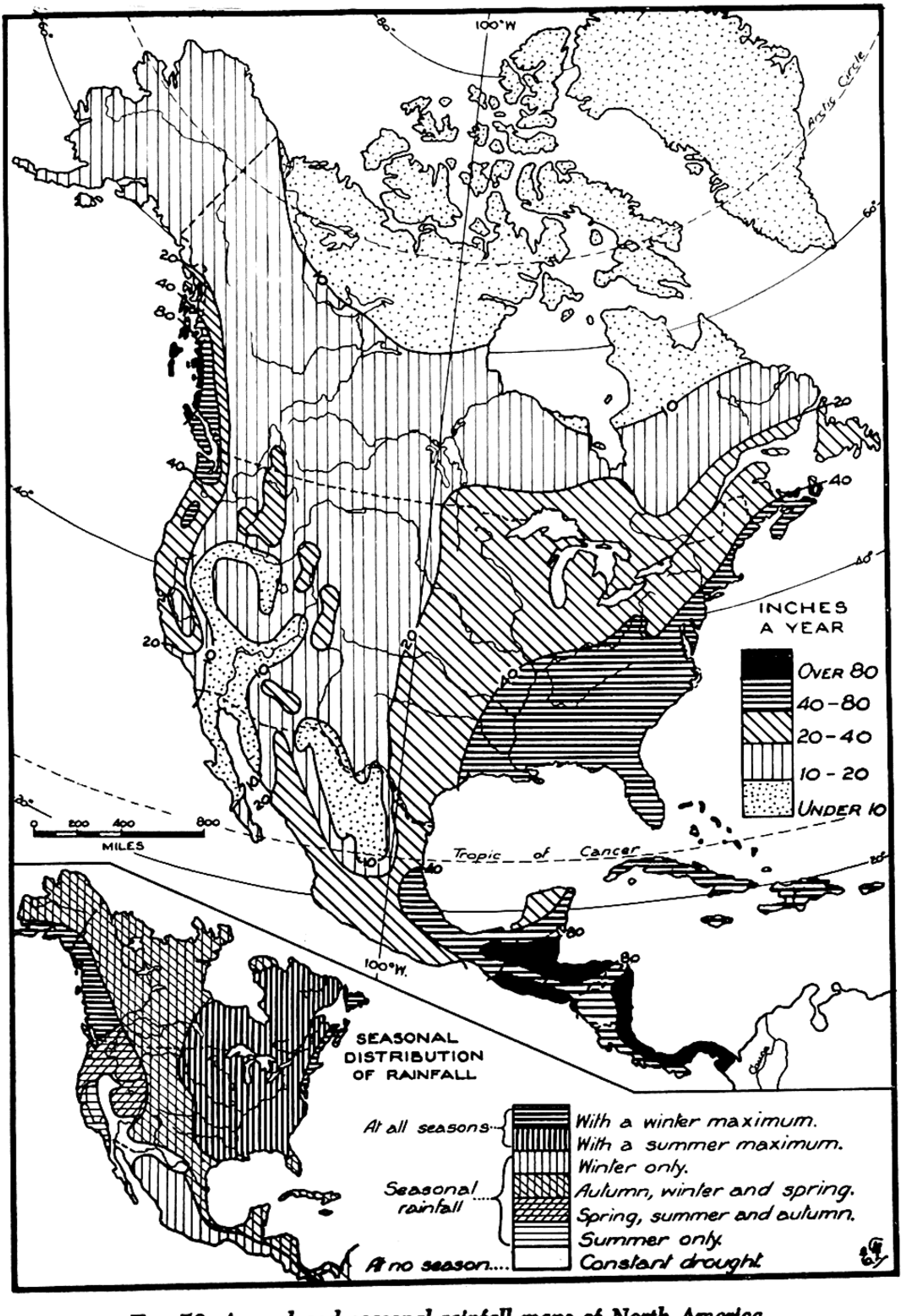


**Fig. 76.** *Annual and seasonal rainfall maps of North America.*

(*e*) The seasonal rain map shows that the well-watered lands of eastern United States have a marked summer rainfall. This means that the bulk of the rain falls during the growing season of the crops. That, combined with the summer warmth, makes this an almost ideal farming region.

## Climatic Types

Figure 77 shows the general pattern of the principal climatic regions of North America. The definition of these types has been partly qualitative and partly quantitative. The various monthly rainfall and temperature graphs are included to bring out the difference between the regions mapped. They will also repay some study on their own account; they tell much about the climatic conditions within each region.

First, notice that this is an equal-area projection with straight parallels of latitude. This makes possible the easy comparison of places in the east and the west by merely running the eye across the map from side to side.

Secondly, note the very regular pattern over the lowlands of the eastern half of the map, as compared with the very irregular pattern where highlands dominate the landforms in the west. In the east there is a regular succession of types, in almost parallel east-west bands, from the humid sub-tropical of the Gulf Plains, through the humid continental (first with warm long summers, then with cool short summers), to the cold continental and sub-arctic types. Here temperature is the deciding factor as we pass from one type to another, with the constant warmth of the near-tropical gradually changing to the constant cold of the near-polar regions.

Thirdly, the west coast under a strong maritime influence shows fewer changes in climate from north to south, though those that do occur are significant. The five climatic regions along the west coast are the tropical summer-rain type (Number 2); the dry continental types (Numbers 3 and 4(a)); the Mediterranean winter-rain area (Number 6) and the west coast marine, a cool temperate moist climate. This is the normal sequence found on west coastland areas stretching from the tropics to the Arctic (or Antarctic). Because of limiting mountains each of these belts is narrow, with the exception of the desert and dry continental, which extend inland into the rain-shadow areas between the main climatic divides of the Rockies and the Sierra Nevada.

### Brief Survey of Climatic Types.

(*a*) *Tropical hot-wet* (Number 1 area on Figure 77). Though not actually on the Equator, this area of Central America has the generally monotonous heat-moisture character of the equatorial zone. The graphs for San Juan, Colon and Belize all show a uniform temperature of about 80°F. with an annual range of not more than 5°. The rainfall of all three places is high, that of Colon being exceptionally so; but only San Juan has the true uniform spread of rain found in equatorial areas. Colon and

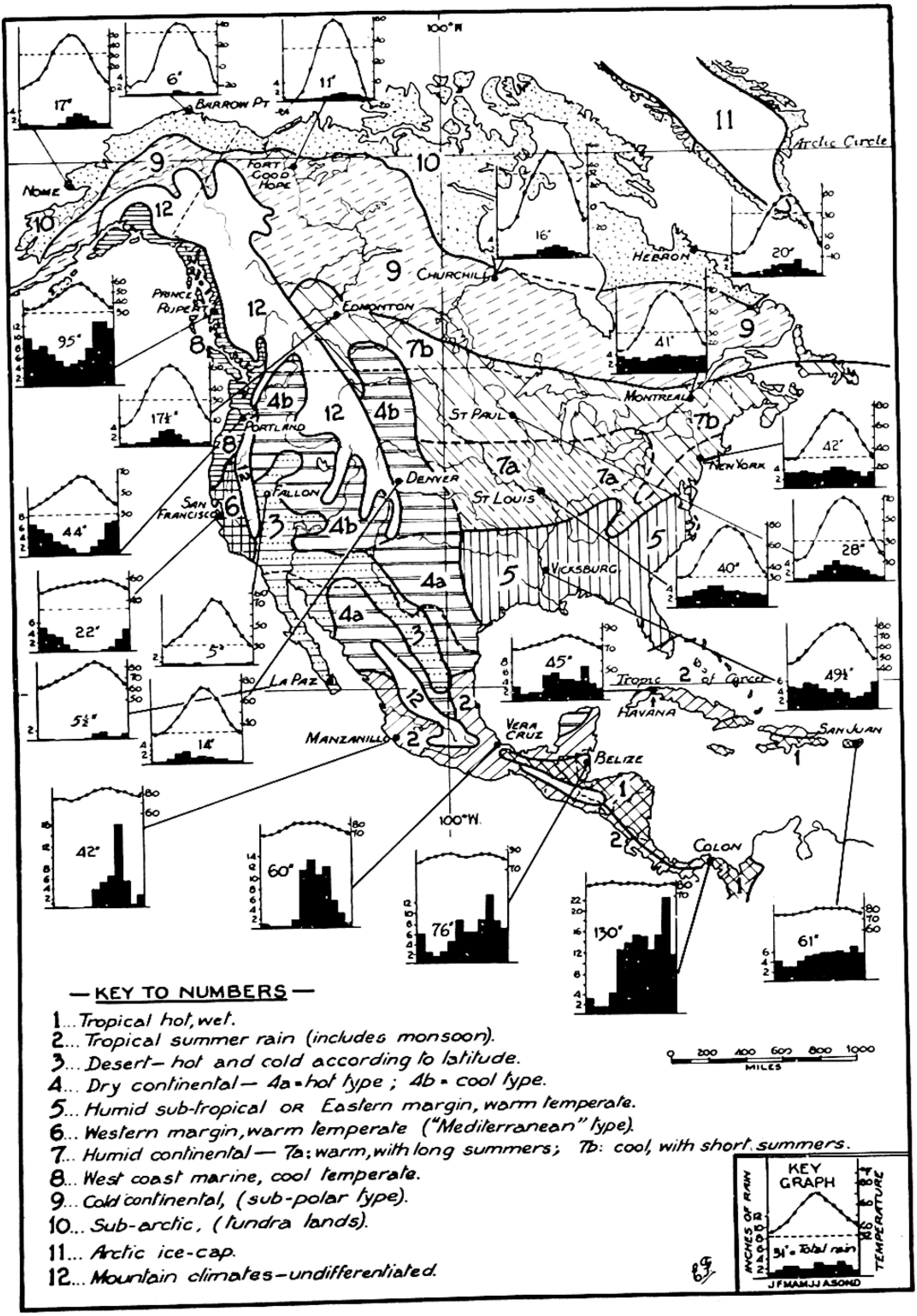


FIG. 77. *Main climatic regions of North America, with climatic graphs of selected towns.*

Belize both show a marked summer and autumn maximum with a short dry season in the early spring period. This summer rain comes from the influence of the trade winds, which reach their peak in late summer and become more pronounced in the Number 2 area, where the graphs of Vera Cruz and Manzanillo show the typical wet tropical shape.

(*b*) *The wet tropical* (Number 2 on the map) occurs on the coastal plains and nearby foothills of southern (or tropical) Mexico, western Central America and throughout most of the West Indies. The range of temperature is slightly greater here than in the tropical hot-wet areas, and the rainfall is almost entirely in summer and autumn. This is a transition type between the constantly wet and the constantly dry areas, so it exhibits the features of each of these at different times of the year. It may be compared with the savanna areas in Venezuela, the African Sudan or the Northern Territory inland.

(*c*) *The desert areas* (Number 3 on the map) are situated in the south-west corner of the continent, where the tropical continental air mass holds sway. The graphs for La Paz and Fallon show the features of the climate as well as emphasise the temperature differences between the southern hotter areas and the northern areas, where elevation and latitude give a much wider temperature range with very bleak winters as a notable feature of the climate there.

(*d*) *The dry continental* (Numbers 4(a) and 4(b) on Figure 77) is a semi-arid type with rainfalls between 10 and 20 inches. Number 4(a) (the hot type) differs from Number 4(b) in its winter temperatures. In 4(a) the winters are generally warm enough to allow for open range grazing, while in 4(b) they are too cold to allow for plant growth except where the areas receive a succession of chinook winds during the winter. The graph for Denver is typical of this area. Notice how the 4(b) type extends north to the Canadian border in the Basin and Range Plateau. This type is very similar to inland Queensland in the Mexican portion and inland Victoria in the Denver area.

(*e*) *The humid sub-tropical* (Number 5 on the map) resembles the central east coastal areas of Australia, though the occasional visit of cold waves each winter is a feature not found in Australia. The graph for Vicksburg is typical and shows a good rainfall very evenly distributed throughout the year. Temperatures range from cool winters to quite hot summers and the summer humidity is very enervating and unpleasant. This is the cotton country and the principal area of Negro population in the United States.

(*f*) *The western margin, warm temperate* (or Mediterranean type: Number 6 on Figure 77). Here we have the typical winter-rain summer-drought climate of latitudes 32° to 38° on the western maritime margins of continents, as, for example, in south-west Western Australia or the Adelaide hinterland. The graph for San Francisco shows its typical moderate rainfall and generally warm temperatures with rather hot dry

summers when the adjoining desert conditions (of Number 3 area) make themselves felt. Abundant sunshine in both winter and summer helps to make this a popular holiday area and an important fruit-growing and drying region where irrigation water is available.

(*g*) *The humid continental* (Numbers 7(a) and 7(b) on the map). As the graphs for St Louis, St Paul, Montreal and New York show, these regions have a generally good rainfall, evenly distributed throughout the year. The Edmonton graph indicates drier conditions, with a more marked seasonal rainfall on the western (i.e., inland) edges of the area. The temperature graphs show the reason for the differentiation into short summer and long summer sub-regions. Number 7(a) type has an average temperature that is above freezing all the year and a frost-free growing period of at least 150 days. Number 7(b) has winter temperatures below freezing for four to six months and a frost-free growing period of only 90 to 150 days. The northern boundary of 7(b) marks the poleward limit for growth (and ripening) of most cereals.

(*h*) *The west coast marine cool temperate* (Number 8 on the map). Here we see the typical western European type of climate reduced in extent by the closeness of the mountains to the coast and with its total rainfall greatly increased by the effect of the same mountains. Under the influence of permanent on-shore westerlies the area has a generally moist and cool climate, with rain at all seasons and much fog for most of the year. The graph for Prince Rupert is fairly typical, though not all areas receive so high a rainfall.

(*i*) *Cold continental* (Number 9 on Figure 77). The approach to the polar regions is evident in this type, which, as the graphs for Churchill and Fort Good Hope show, has a moderate rainfall and a very wide temperature range. The winters are long and very cold; note the -20°F. average for midwinter in both places, that is, over 50° of frost. The summers are short and quite warm, with a 60° average almost everywhere. The growing season here is too short for most commercial crops, though quick maturing types do well under the constant Arctic sunshine of summer.

(*j*) *The sub-arctic or tundra* (Number 10 on the map). Here the general conditions of Number 9 type are further accentuated by the closer approach to the Pole. Winters are long, dark and bitterly cold, and summers are very short and barely warm. The precipitation is very slight, though the low evaporation allows for the accumulation of much snow in winter and water into marshy areas in summer. Tree growth is impossible under these climatic conditions and the tundra is characterised by the growth of mosses, lichens and flowering ephemerals.

(*k*) *Arctic and mountain types* (Numbers 11 and 12 on the map). The Arctic type is an ice cap, unvegetated and uninhabited. The mountain areas have very mixed climates owing to the great difference in elevation in them. The valleys in many instances have moderate temperatures and

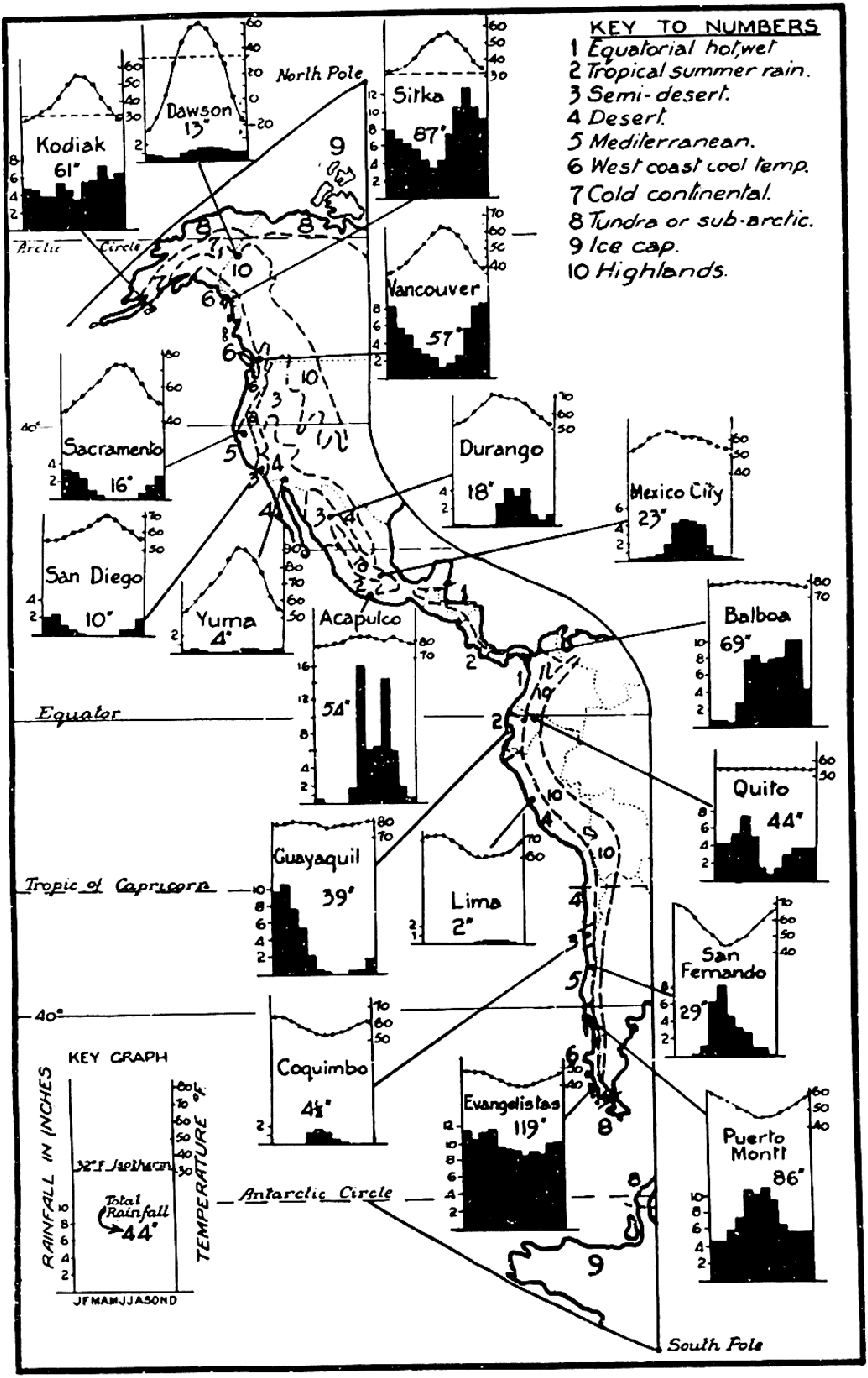


FIG. 78. *Climatic traverse along the west coast of the Americas.*

rainfalls and are inhabited, though they be overlooked by towering snow-covered peaks. In them air drainage (i.e., the sinking of cold air to the valley bottoms at night) causes many mists and fogs in the lower valleys; also many of the intermontane valleys run longitudinally for very great distances. This allows free passage to cold polar air in the winter. The valley of the upper Fraser and Columbia rivers is an example. Figure 75 suggested the rainfall features of the Canadian mountain areas and these would tend to be repeated in the mountain areas of the United States. The interesting feature here is the very low rainfall on the valley bottoms which are excellent examples of rain-shadow areas.

## Climatic Traverse along the West Coast of the Americas

The climatic survey from Alaska to Cape Horn (on Figure 78) serves to emphasise the generally parallel development of climatic types north and south of the Equator. This parallel zoning was noted in Africa, where the Equator bisected the continent and gave an almost perfect duplication of types both north and south from it. Here the same duplication is apparent but in a modified and more irregular form because of the closeness of the mountains to the coast. Starting from the Equator on Figure 78 and working north we note the sequence of types as 1, 2, 3, 4, 3, 5, 6, 7 and 8, with 9 and 10 inland. Southwards the sequence is 1, 2, 4, 3, 5, 6, 8, 9, the significant absence here being Number 7 (the cold continental type) because of the narrowing of South America to its apex in latitude 55° S.

When studying the graphs of the various selected centres it is important to remember the difference in seasonal times in northern and southern lands. Thus the graph for San Fernando (Number 5 in Chile) is almost identical in type with that of Sacramento (California). Both are winter-rain summer-drought areas, though their graphs appear to be opposites. Similarly with the graphs of Puerto Montt and Sitka (or Vancouver) and Guayaquil and Acapulco. Quito and Mexico City graphs have been added as examples of mountain climates. Quito is on the Equator and shows the uniform temperature graph (though at some 30° lower than places on the equatorial lowlands) and Mexico City shows a similar modification of a tropical lowland climate

### EXERCISES

1. **Vocabulary words and phrases:** air mass, source regions, polar front, cyclone, anticyclone, chinook winds, tundra.

2. Draw a map of North America and mark on it the main climatic barriers. Show also the ocean currents along its shores and discuss the effect of ocean currents and mountain barriers on the climate of North America.

3. Give a reasoned account of the differences in climate of the following places (a) Vancouver, (b) Winnipeg, (c) Montreal, (d) Halifax.

4. Explain the differences in climate found on the western coast of North America between Panama and Alaska.

# CHAPTER XXIV

# SOILS OF NORTH AMERICA

## World Soil Types and their Characteristics

Before studying the nature and distribution of the major soil types of the world in general and North America in particular, it would be useful for us to refer to the work we did in our discussions of the soils of Africa. There we noted something of the ways in which soils are formed, how they may be changed and the methods of classifying them. In doing so we explained the meaning of leaching and the soil profile and how these were related to the grouping of soils into two broad types called the pedalfers and the pedocals. It will be seen in Figures 79 and 80 that these form the basis of our present description of the soils of the world and North America. As was also mentioned we must constantly bear in mind the close relationship between their distribution and those of landforms and climate as well as present and potential land use.

Figure 79 shows that the principal soil types of North America are closely correlated with the climatic regions and the landforms. As is usual with soil maps of a general nature, all the mountain areas are indicated as having undifferentiated soils (Number 9 area on Figure 79). Here there is a general absence of real soil from much of the steeper land and an accumulation of transported and unsorted soils in valley bottoms. Some of these may be deep and fertile if they have been *in situ* long enough to allow for the soil-forming agencies to rearrange their minerals and stabilise their general composition. Otherwise many of these valley soils are poorly drained and peaty or boggy. Peat and swamp soils also tend to form over much of the flat areas of high ground where the drainage is poor. Elsewhere in North America the acid pedalfers occur essentially in the areas of higher rainfall and lower evaporation and the alkaline pedocals are found in the drier High Plains and the Basin and Range plateaux.

Taking each of these soil types in turn, we will note something of its character and agricultural potentialities. (The numbers correspond to those used on Figure 79.)

### 1. Pedalfers.

(*a*) *Tundra soils* occurring throughout the tundra climatic region are characterised by a shallow surface soil resting on a frozen subsoil. The surface soil thaws out to a maximum depth of a few feet each summer and freezes again each winter. Under these conditions there tends to

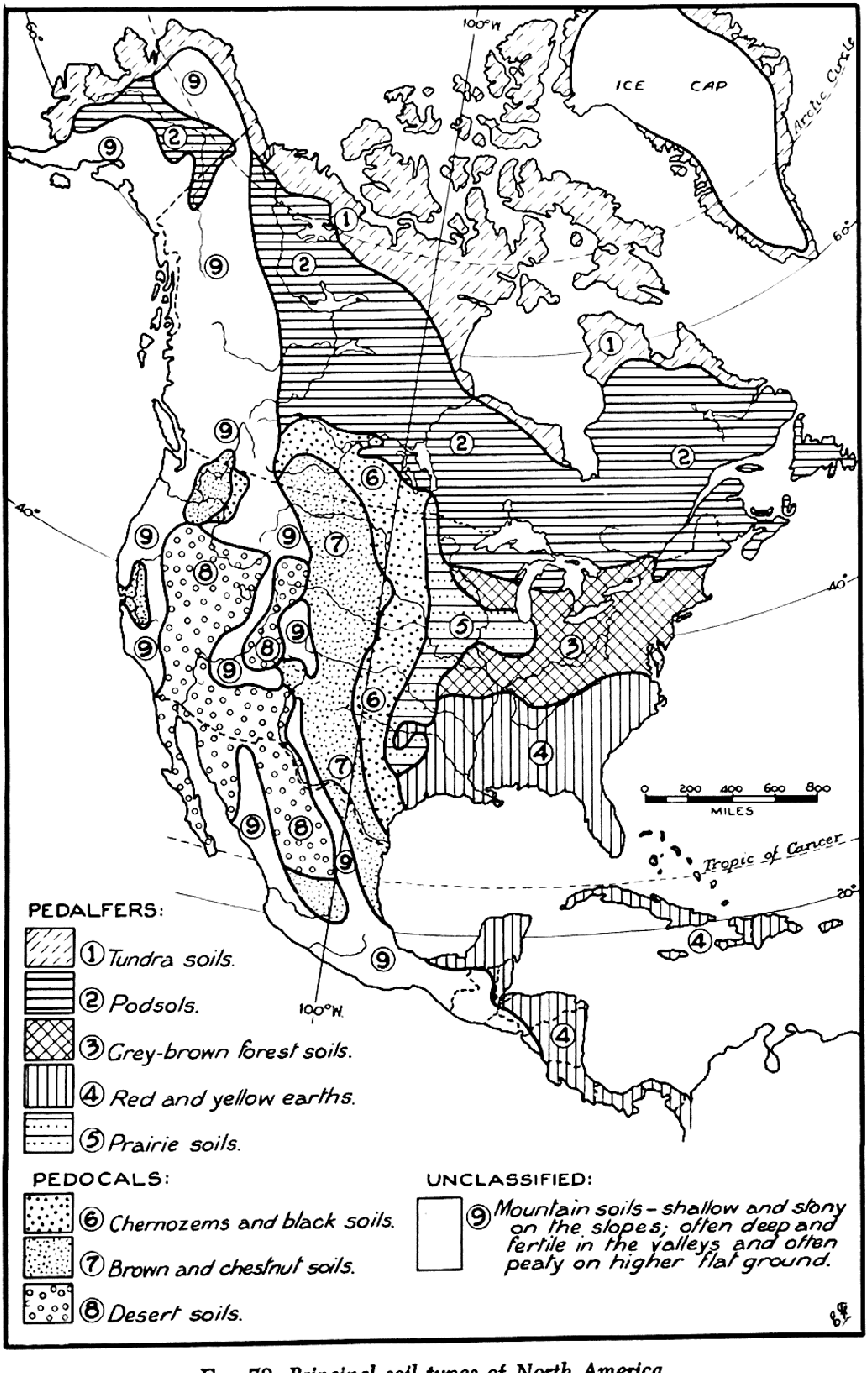


FIG. 79. *Principal soil types of North America.*

be an excess of moisture in the soil, so that the prevailing soils are those of bog or marshland. Only on better-drained slopes with a sunny aspect do such soils offer much possibility for growing some quick-maturing agricultural crops. Figure 80 shows that the tundra soils continue as a broad belt across the top of Eurasia.

(*b*) *Podsols.* The process of podsolisation consists of the removal from the A-horizon of all soluble minerals except silica and their partial concentration in the B-horizon. It is a special process of leaching occurring under cool moist climatic conditions. True podsols are found essentially in the coniferous forest belts of the northern hemisphere, but the process of podsolisation extends far beyond the coniferous forest area and partly podsolised soils (called podsolic soils) are found throughout the temperate deciduous forests and even in tropical and sub-tropical forest areas (see Figure 80).

In the true podsol a thin layer of raw humus or half-decayed organic material forms on the surface and overlies a leached sandy, whitish-grey A-horizon. The line of separation of the raw humus and the whitish sand is sharp and clear because of the absence of earthworms, which elsewhere, in less highly acid soils, aid in mixing organic material with the upper soil layers. The B-horizon is typically shallow in the true podsol, rarely exceeding 18 inches in depth, and is yellowish-brown or dark brown in colour. It contains very few soluble plant foods and sometimes is cemented into a hard clay pan. The general physical and chemical properties of podsols gives them a low fertility. Figure 79 shows that they occupy much of Canada and the New England States of the United States.

(*c*) *Grey-brown podsolic forest-soils* develop largely under a deciduous forest cover, though, as Figure 80 shows, they also occur in forest areas of eastern Australia, China and South Africa. In North America their spread corresponds closely with that of the mixed deciduous forest zone of the eastern United States (see Figures 79 and 81). They are mildly acid and moderately leached soils. A thin layer of organic material, partly decomposed, overlies an A-horizon of coarse-textured sandy material stained brown by iron solution and rather heavily leached. The B-horizon is again a yellowish-brown clayey material. The general depth is between two and three feet and the structure, humus content, and water-retaining properties are better than either in podsols or laterites. Consequently the grey-brown forest soils are of medium fertility, and, under careful farming methods, have developed into some of the most important agricultural lands in the world in China and Japan, western Europe and north-east United States.

(*d*) *Red and yellow earths* are characteristic soils of low latitudes and, as we have seen, form the major soil types in Africa and South America. They occur in North America throughout the cotton belt, and in Central America and the West Indies (see Figure 79) and they are significant as well in south-east Asia and northern Australia (see Figure 80). They

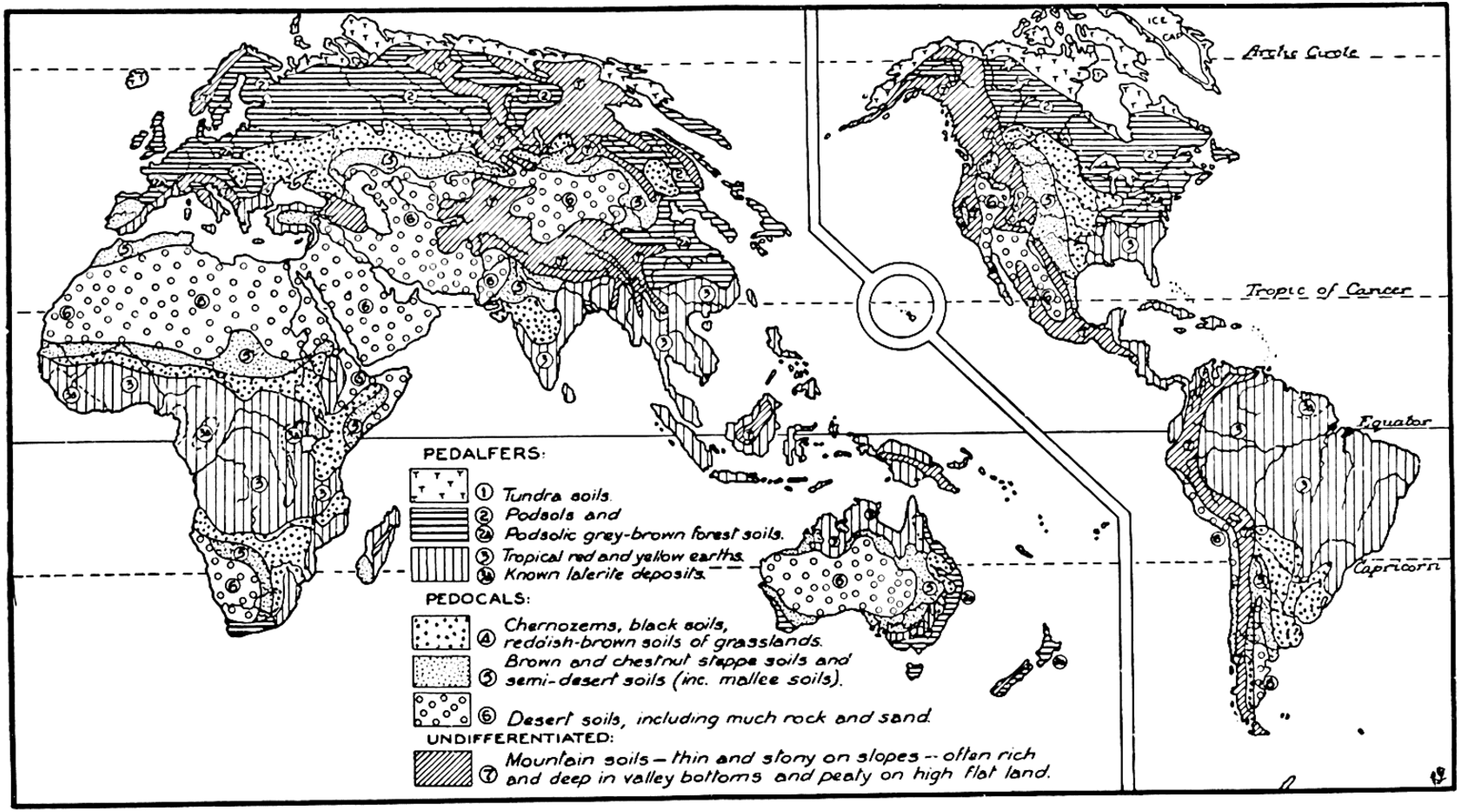


FIG. 80. Generalised soil map of the world.

develop under forest cover in areas of heat and high rainfall. These soils shows the effect of both laterisation and podsolisation. In true *laterites* the A-horizon is leached of all minerals except iron and aluminium oxides and it has a reddish coarse-textured (pebbly) and very porous A-horizon of a few inches in depth. This is underlain by a clayey B-horizon of several feet in depth and often with a hard ironstone layer running through it. These true laterites are rare and most tropical and sub-tropical soils are lateritic in character rather than fully laterised.

The red and yellow earths have usually a brown friable loamy A-horizon resting on a deep clayey B-horizon. They are fairly rich in humus and have a fairly high agricultural potential. Because of the generally high leaching of these climates the red and yellow earths have to be farmed with care.

(*e*) *Prairie soils.* These are a slightly acid type of soil that develops under a cover of tall grass rather than forest, although the rainfall is ample for tree growth. On Figure 80 they are included with the chernozems with which they have many affinities. Prairie soils have a fine granular texture with a very dark colour. The A-horizon is deep and contains an abundance of humus from decaying grass roots and fibres. It rests on a B-horizon of several feet in depth in which there is an abundance of plant foods. Unlike the chernozems, which they otherwise resemble, they have no layer of lime accumulation in the lower B-horizon. Prairie soils (or prairiearths as they are sometimes called), because of their high humus content, their good structure and excellent moisture holding properties, are among the most productive agricultural soils in the world. The main areas of these soils are found in the United States (Figure 79), south-east Europe, southern Russia, Paraguay, south-east Brazil, northern Argentina, African Sudan and patches in central Asia.

**2. Pedocals.**

(*f*) *Chernozems and black soils.* These form under a dense vegetation cover of prairie and steppe grasses where the annual rainfall is sufficiently low to allow for an accumulation of lime minerals in the B-horizon. The low rainfall also results in a high percentage of fine and colloidal material remaining in the soil to give it a characteristically heavy and clayey texture. In chernozem soils the A-horizon is deep (often several feet) and black in colour. This slightly leached layer grades down into a dark brown B-horizon with a layer of whitish nodules of calcium salts accumulated in its lower levels (usually from two to four feet from the surface). The high organic content of chernozems renders them extremely fertile, though their location on the margins of the humid lands limits the variety of crops that may be grown in them. They have become the great wheat-producing areas of the world.

On Figure 80 the chernozem belt (Number 4 region) also includes black soils derived from lava flows as in the Deccan of India and Queensland.

(*g*) *Brown and chestnut soils* are common on the desert margins of the world; they lie between the sub-humid chernozems or red and yellow earths and the arid desert soils. Their vegetation cover is grassland and scattered trees, and under these conditions the soils have a lighter colour and a more open texture than the true chernozem. The A-horizon is dark brown in colour and is usually less than a foot in depth. It contains some humus and is very slightly leached. It rests on a B-horizon of brown clay in which the zone of lime nodules is closer to the surface than in the chernozems, usually about two to three feet in chestnut soils and only about one foot in brown soils. They would be excellent agricultural soils if the rainfall were higher; as it is, they are dominantly livestock grazing areas.

The outstanding areas of chestnut and brown soils are those of the High Plains in North America, Argentina, inland Australia, the Russian steppes and the Sudan and Kalahari fringe in Africa.

(*h*) *Desert soils* are very shallow. Much of the desert land is covered with rock or sand, but soils do occur in isolated patches. The areas marked in Figures 79 and 80 include the sand and rock areas as well as the true soils. The soils develop under the cover of sparse vegetation and have an A-horizon a few inches in depth resting on a limy B-horizon. There is very high accumulation of alkaline salts (salt, gypsum, lime) in both the A- and B-horizons which are often cemented into a hardpan layer by them.

(*i*) *Mountain soils.* In western North America many of the mountain areas are under a forest cover. As a result the soils in the valleys and on the lower slopes are podsolic in character. This is particularly the case in the States of Oregon, Washington and British Columbia.

**3. Man and the Soil.** By using soils for farming man has made profound changes in soil structure and soil processes over much of the agricultural lands of the world. One of the first actions of a farming community is the removal or destruction of the natural vegetation cover in order to grow crops. This removes one of the natural controls of soil formation and upsets the balance of the soil environment. Wise farming methods, using systems of crop rotation, ley farming and chemical fertilising, can do much to restore, maintain or even improve the orginal texture, structure, and fertility. Too often pioneer farming practices tend steadily to destroy the original features of the soil and to convert it into a sterile wasteland. Ploughing and cultivating soils alter their texture and structure and change the natural processes of soil formation, especially the movement of soil moisture through A- and B-horizons. Increased cultivation therefore may have two major effects on the soil: (*a*) it may alter the mechanical and chemical processes within the soil; (*b*) it may result in soil depletion, i.e., in the steady loss of soil fertility. Both of these are potent factors in soil erosion. Correct soil management can prevent both soil depletion and soil erosion, and the major work of the Conservation Departments in the United States, Canada, Mexico, and countries elsewhere throughout the

world, is centred on the education of farmers in the correct methods of soil management. As this varies with different soil types and different landforms and climate, each farming area (often each farm) has to be studied as a separate problem. The wise farming methods of crop rotation, soil fertilisation, and ley farming with sown leguminous pastures are generally basic to all areas.

## EXERCISES

1. What are the characteristics of (a) cyclonic, (b) orographical and (c) convectional rains? In your explanation give suitable examples for each type.

2. Draw a map of the climatic regions of North America. On a piece of tracing paper trace its outline and then mark in the soil zones on your traced map. By using the two maps discuss the general relationship between soil types and climatic regions in North America.

3. Using examples from South America and North America, write an essay on the effects of altitude on changing the nature of the climate, the natural vegetation and the soil types.

4. Describe and account for the differences in coastal landforms in Eastern U.S.A. Indicate the significance of these differences in the distribution of ports in this area.

5. Discuss how climate, soil and topography may combine to give a region a distinctive character. Use examples from Africa, South America and North America to illustrate your answer.

6. Compare and contrast the physiography, climate and soil types of the Mississippi Valley below St Louis with that of the Parana below Corrientes.

7. What characteristics are considered in describing a soil? Show on a map of North America *or* South America the chief soil groups. Take any three groups and discuss their agricultural significance.

8. Discuss the nature and development of land surfaces in regions experiencing (a) glacial, (b) arid and (c) humid conditions.

9. What is a soil and of what is it composed? Select any three regions of North America and point out how their soil characteristics have been affected by climate.

10. Compare and contrast the landscapes of California, Oregon and Washington in the United States with those of Chile.

11. What are the characteristics of the climates found between the tropics? Describe any one type in detail and show its effect upon human activity.

# CHAPTER XXV

# VEGETATION AND LUMBERING

Because of its size and great latitudinal range North America is covered with a wide variety of plants from tropical jungles to Arctic tundra. Over most of the continent the rainfall is sufficiently high to support tree growth, hence forests and woodlands are the main vegetation types. Arid lands occupy a relatively small portion in the south-west, but grasslands form a dominant vegetation type over a large area in the interior of the United States. A large proportion of the northern areas (including the groups of Arctic islands and Greenland) is covered with tundra or is completely barren.

Figure 81 shows the pattern of vegetation over North America and it should be referred to constantly in reading this chapter. The numbered headings that follow correspond with the numbers on Figure 81. The map indicates the vegetation pattern existing before the advent of European peoples, who have removed much of the natural vegetation in farming areas to make way for crops.

## Forests

**1. Coniferous and mountain coniferous.** The main area of these extends through central and southern Canada as a belt 3000 miles wide from east to west and 600 miles deep from north to south. The climatic conditions of long severe winters, warm summers, and rather low rainfall, together with the soils of glacial clays, gravels, and sands are favourable to the growth of hardy evergreen conifers rather than broad-leaved deciduous trees. On the northern margins the trees are scattered and stunted, with real forests occurring only on river banks. Elsewhere they grow in dense clumps scattered among lakes and swamps.

One of the most remarkable features of the vast Canadian forests is the small number of species. Generally the various types occur in pure stands of only one tree. This is in strong contrast with the great variety found in equatorial forests and is of great assistance to profitable lumbering. The chief types are spruce, balsam, fir, pines, hemlock, larch and aspen (called poplar in Canada). Much of the timber of these northern forests is suitable only for wood-pulp and paper making, and the world's greatest pulp and paper industry has grown up in the St Lawrence Valley and New England States of the United States. All types of paper are made here, but newsprint and book paper easily outstrip the others. The Canadian area alone produces over half the world's newsprint.

The animal life of the coniferous forests furnishes another source

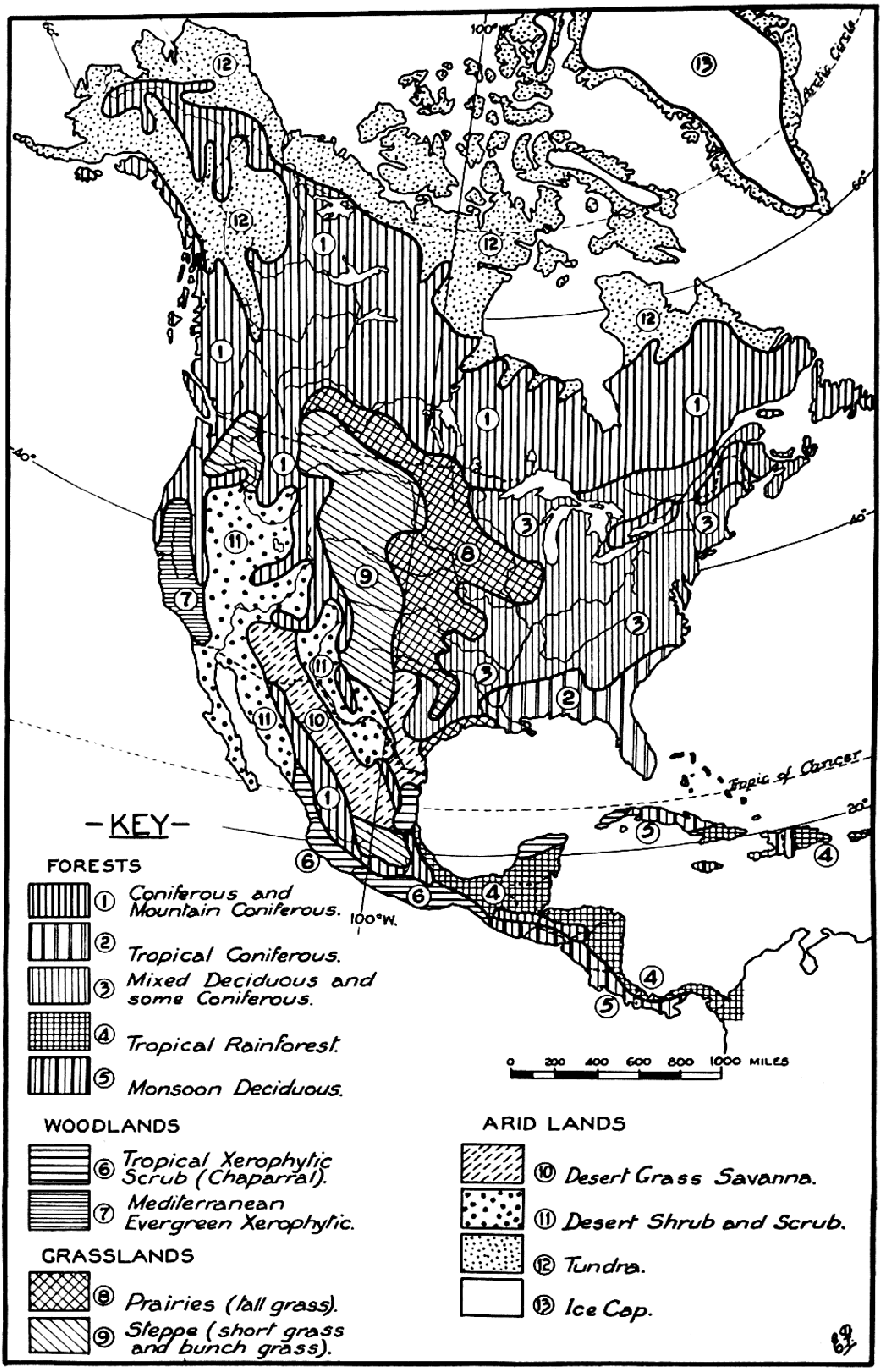


FIG. 81. *Generalised vegetation map of North America. Note that this map shows the original vegetation cover and not that of today.*

of wealth. The large animals include the moose, the caribou and bears; but it is the smaller fur-bearing types such as the beaver, marten, musk rat, mink and Arctic fox that are the main animals trapped and hunted.

On the Coast Ranges of British Columbia, Washington and Oregon the temperatures are so mild and the rainfall is so abundant that conifers grow to giant size and are the most magnificent in the world. Here are spruces and cedars in addition to the giant Douglas fir (or Oregon pine) which often attains 300 feet in height with a girth of 10 to 14 feet. Lumbering and export of lumber products are a major activity in these States, though considerable quantities of paper and paper-pulp are also produced (e.g., British Columbia produces about 500,000 tons of paper and pulp a year). The Sierra Nevada Mountains of California are also clothed with coniferous forests, and it is here, under special conditions of fog and rainfall, that the giant sequoias (or redwoods) grow. Early lumbering almost wiped out this magnificent and useful softwood, and most of the present sequoia forests are in National Parks.

Pine and spruce forests occur as well on the middle slopes of the Rockies throughout Idaho (which has the world's largest sawmill), Montana, Wyoming and Colorado, and lumbering is an important industry in each of these States (see Figure 82).

**2. Tropical coniferous forests** occur in a broad belt along the Gulf Coast and in Florida and Cuba. These south-east States are the second largest lumbering area in the United States (see Figure 82), and the yellow pine from here accounts for nearly 20 per cent of United States timber production. Important trees here include Caribbean pine, loblolly, slash pine and yellow pine. Because of the near-tropical climate, lumbering is carried on all the year round. Paper-pulp is only of secondary importance here, though the building of new mills (such as the Bowater mill in Tennessee) is increasing its significance. Turpentine and resin are important by-products from these pine forests.

**3. Mixed deciduous forests with some coniferous trees** occur over the wetter regions of the Atlantic Coast Plain, the Appalachian and the central plains of the Mississippi Valley. Over this huge area are deciduous trees in the north, where the winters are cold, and evergreen broad-leaved trees in the south, where the winters are warmer. Along the St Lawrence Valley, round the Great Lakes and in the New England area is one of the richest forest areas in the world. On sandy soils pines predominate (yellow pine, pitch pine and Weymouth pine); on wetter ground are cedar and hemlock-spruce; and on richer and deeper soils oak, chestnut, birch, beech, walnut, hickory, plane, ash, elm, maple and lime are mingled with the pine and cedar. Along the Appalachians and out on the central plains great variety of trees continues, though only traces of the former wealth of timber now remain, so great have been the inroads made by the farmer and lumberman. The warmer forests have an undergrowth wonderfully

rich in flowering shrubs like rhododendron and magnolia, while the Virginia creeper adds its blaze of glory to the landscape in autumn.

Lumbering is still an important industry throughout this forest area, as it is the major source of commercial hardwoods in the United States (see Figure 82).

**4. The tropical rain forests** occur on the wet lowlands of Central America. Here the low-lying coasts are usually fringed with mangrove swamps, stinking, repulsive and insect-dominated. Behind the mangroves on the firm ground of the coastal plains and lower mountain slopes rises the typical two-storied rain forest in which the trees are wreathed with lianas and draped with epiphyte ferns. Among the valuable timbers from this area are logwood, mahogany, ebony and dyewoods. One of the world's great commercial banana-growing industries has been developed in clearings at points along the coastal lowlands. The bananas are grown for United States markets, and the industry and transport are mostly controlled by the United Fruit Company, which affords an excellent example of plantation development in tropical lands as well as vertical integration in the control of an industry.

**5. Monsoon deciduous forest.** This small patch of tropical deciduous forest occurs on the limited monsoon area of Central America. The trees are evergreens, but, like all tropical deciduous types, they shed most of their leaves during the hot pre-monsoon season. There has been very little economic development of the valuable hardwoods found in these forests.

## Woodlands

**6. Tropical xerophytic scrub** (or chaparral) grows in tropical areas with a moderate rainfall. It consists of low scrub trees which are broad-leaved deciduous, dropping their leaves in the dry season. Sometimes the trees grow in thickets interspersed with grassy areas, at others they are scattered over grassy landscapes. The land here is of little value.

**7. Mediterranean evergreen xerophytic** (maquis or chaparral). Here is a mixed forest of low trees and woody shrubs. The trees are widely spaced, with massive trunks and gnarled spreading branches. The ground between the trees is covered with a pale dusty bush vegetation and tall spiky tuft grasses. As a protection against evaporation the trees have thick deeply fissured bark and thick leathery leaves with hard shining surfaces (this type of leaf is known as *sclerophyllous*). A more common type of Mediterranean vegetation is a covering of shrubs and bushes, often with thorny spikes, called chaparral or maquis. In California the better-watered areas have evergreen shrubs, laurels, cypresses and evergreen oaks, while enormous areas are irrigated for the growth of typically Mediterranean fruit crops (the orange, olive and grapevine).

## Grasslands

**8. Prairies (or tall grass areas).** The prairies occupy the heart of the continent in a broad belt stretching along the Great Plains from Canada to the middle of Texas. This is a luxuriant grassland where the grasses grow up to three feet in height. Trees are found only in thin lines along the watercourses and the area is a blaze of flowering plants in spring. These were frightening areas to the early settlers pushing westward from the forests of the Ohio and Great Lakes. Here was a land with no timber for building or firewood, no shelter for animals and with a sod too tough for the iron-tipped ploughs. The early settlers shunned the prairies and merely crossed them to settle as hunters, trappers and farmers in the familiar vegetation of the forests of the Rockies and the north-west States. The railway, the steel plough and coal have enabled man to conquer the prairies and to convert them into one of the greatest and richest farming areas in the world.

**9. Steppes.** The short grass steppe lands extend west of the prairies over the High Plains bordering the eastern flanks of the Rockies. Here a mixture of hardy tuft grasses and fine soft grasses mottles the earth. On the drier margins, cacti and thorny shrubs appear, while the sage-bush is common along the foothills of the Rockies. This is excellent pastoral country and although the agriculturalist has penetrated the wetter eastern steppe margins, the precarious nature of arable farming throughout these semi-arid grasslands will cause them to remain dominantly grazing areas.

## Arid Lands

**10. Desert grass and savanna.** This type of vegetation is found in the bolson country of Chihuahua and Coahuila in northern Mexico and in Arizona in the United States. These areas of alluvial fan deltas in basins of inland drainage have sufficient summer rains to grow grasses, but the permanent vegetation consists of xerophytic types adjusted to the generally harsh environment. Saltbush and sagebush are common shrub types while acacia and mimosa are the principal tree types. The agave and cactus (of all sizes and shapes) are scattered among the other kinds of vegetation. This is a tough environment useful for cattle grazing where water is available either in permanent streams coming from the surrounding mountains or from underground wells.

**11. Desert shrub and steppe.** This area is similar to Number 10 but is generally more arid and less vegetated. Sage and cactus are the dominant types of vegetation, though an abundance of ephemeral grasses and herbage plants appear after the occasional seasonal rainstorms, which occur in winter in the northern (Nevada, Utah and southern California) section and in summer elsewhere. Because of this herbage growth these deserts are used for seasonal grazing by the ranchers from surrounding

areas. Several important Indian communities also live here; they depend on a simple agriculture based on local permanent water-holes and on grazing sheep and goats on the scanty desert pasturage. European settlers have developed large-scale gravitational irrigation works in many river valleys, the Imperial Valley of California being one of the greatest.

12. **Tundra** occupies a vast expanse in the north of Canada, the northern islands and Alaska, where the climatic conditions are so severe as to freeze the subsoil permanently. The surface soil freezes in winter but thaws out to a depth of a foot or two during the short summer. Under those conditions only certain shallow-rooting and swamp-loving plants can grow. The chief vegetation is mosses, lichens and dwarf bushes in more favourable localities where drainage and warmth are better. Rhododendrons, birches, willows, cranberries, crowberries and bear-berries are some of the more common types. At the height of summer on more favourable areas a wealth of beautiful flowers carpets the ground: some of these are the Arctic poppy, saxifrage, buttercups, harebell and gentian.

The plant life of the tundra is sufficient to support a fair variety of animal life among which may be noted two main groups: (*a*) the animals dependent mainly on the sea, such as seals, walrus and fish and the polar bear that lives on them; (*b*) the land animals that depend on the vegetation, scraping the snow aside with their hooves to get to it in winter; the caribou, musk-ox, Arctic hare and the imported reindeer are examples. It is important to note here that the mosses and lichens of the Arctic have a very high food value per unit of weight and lose very little of this value when they die in winter. They are an excellent fodder throughout the year. Other animals include the Arctic fox (valuable for his winter fur), the snow rabbit, and countless millions of migratory birds that move into the region for breeding during the summer months.

One of the worst features of the tundra is the swarms of large and vicious mosquitoes in the summer. Added to plagues of flies, these can make life almost unbearable there in the hotter months.

13. **The ice cap** of Greenland and Baffin Land is a barren waste of ice and snow which is without any life whatever.

## Lumbering

The North American forests, as shown on Figure 81, contain a greater variety of valuable trees than is to be found in any other continent. During the opening up and settlement of the continent in the nineteenth and early twentieth centuries vast areas of forest land were destroyed to make way for the farmers. Despite this destruction and the appalling forest wastage resulting from uncontrolled lumbering methods, there are still over three million square miles of forest land in North America. Of this about 25 per cent may be regarded as accessible for commercial

lumbering operations under present conditions. Of the remaining good forest land, Canada has about 450,000 square miles, the United States about 200,000 square miles and Mexico, Central America and the West Indies about 150,000 square miles.

The commercial timbers may be divided broadly into five main groups:

**1. The Pacific Coast and western mountain forests** of Douglas fir, spruce, and cedar. These are all softwoods of high commercial value. A reference to the circle graphs on Figure 82 will show that this is the greatest lumbering area on the continent. Nearly half the sawn lumber of the continent comes from the five regions shown on the map, with the Pacific north-west alone producing about 25 per cent of all the sawn timber of America. Notice here that the map (Figure 82) refers only to sawn lumber and does not take into account the production of pulpwood timber, mining timber (pit props) or firewood. These products would account for an equal amount of timber to that used as sawn lumber. The Pacific Coast forests have recently started to manufacture paper and paper-boards, and in 1953 the area produced approximately one-fifth of the output of these products in the United States.

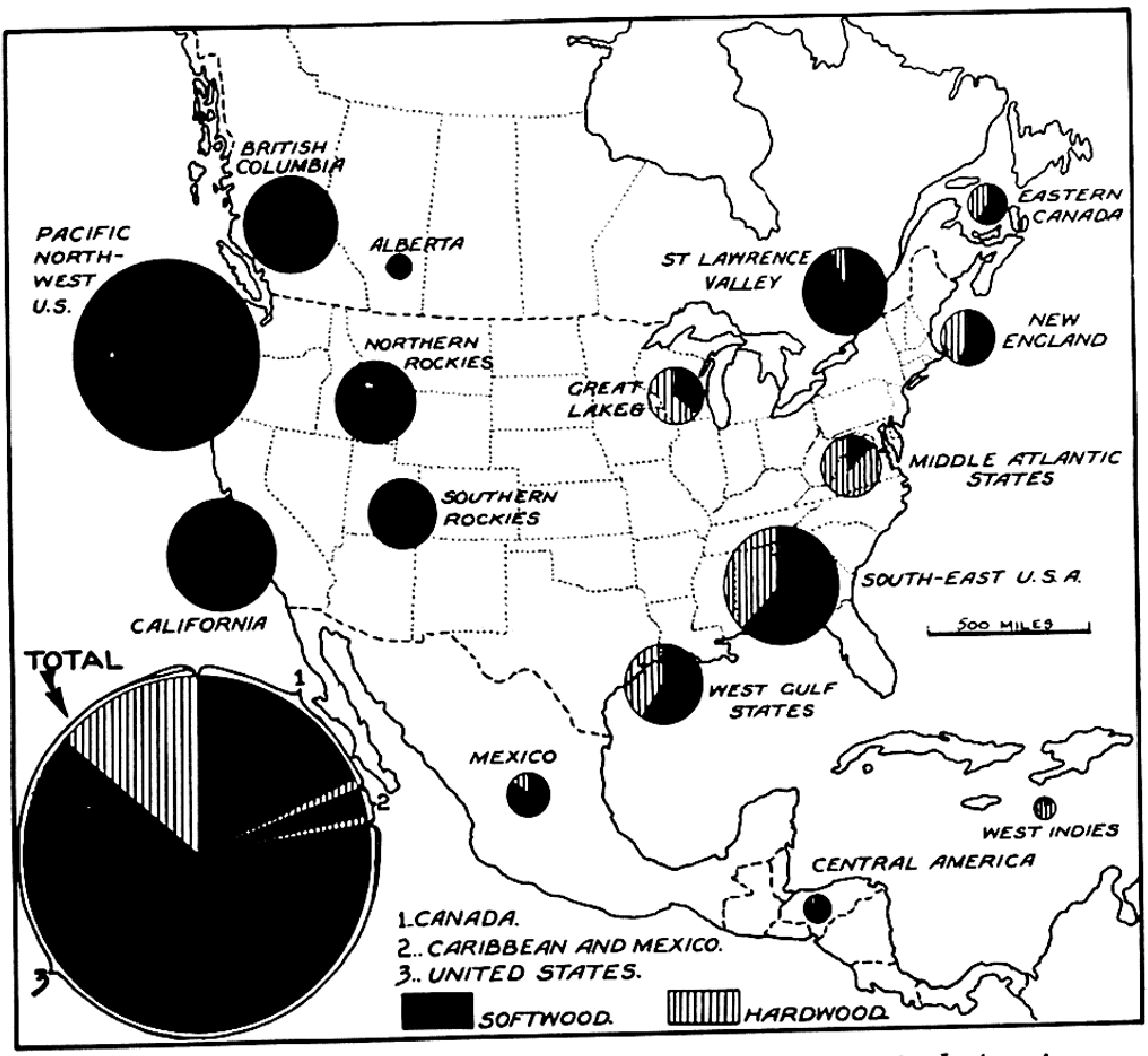


FIG. 82. *Diagram map of the distribution of lumbering in North America.*

2. **The northern coniferous forest belt** of Canada of which the eastern part only is used commercially. Besides the typical spruce, fir and poplar, this area also produces small amounts of hardwoods, such as maple, birch and beech. The eastern (or St Lawrence) forests produce 85 per cent of the Canadian paper and pulp output and are the world's greatest paper manufacturing area. The output of wood-pulp is now over eight million tons a year, and the newsprint production along the St Lawrence Valley, in Nova Scotia and Newfoundland is five times as great as that of any other country in the world. Vast quantities of pulpwood and newsprint are exported from here, and in 1953 made Canada the largest exporter of newsprint (12 times as much as any other country) and the second-largest exporter of pulp in the world (close behind Sweden, which was first).

3. **The mixed northern forests** of the Great Lakes, New England and middle Atlantic States. Here the pines and associated softwoods give way to hardwoods of which hickory, oak, maple and beech are the most important. As the graphs of these areas on Figure 82 show, only in New England is the hardwood production less than the softwood. Originally all the north-east of the United States was clothed with magnificent forests, but, because of the suitability of the country for agriculture, over 80 per cent of the trees have been cut down and the land on which they grew cleared for the plough.

4. **The southern mixed forests**, where hardwoods and pines grow in intermingled stands. For a long time these forests (shown on the map as south-east United States and west Gulf States) have been a major source of both hardwood and softwood timbers. The pine forests yield enormous amounts of turpentine and rosin (the distilled solid obtained from resin) as well as being one of the main paper-pulp, paper-board (for carton manufacture) and newsprint producing areas in the United States.

5. **The Tropical forests** of Central America and the West Indies. Lumbering for coniferous softwoods is important in Honduras (the timber is exported mainly to Cuba), but elsewhere tropical hardwoods such as mahogany, logwood and dyewoods occur.

**Paper- and wood-pulp.** The development of the pulp and paper industry during the present century has been one of spectacularly increasing outputs; and the United States and Canada have led the world in this expansion.

In 1901 the United States produced 1½ million tons of paper and pulp; by 1938 the figure had increased to six million tons, by 1944 to 10 million, and by 1953 to 17 million tons. The Canadian increase has been equally significant and has risen from well below one million tons in 1901 to nine million tons in 1953.

The wood-pulp, originally used only for paper, now furnishes the raw material for a host of other products, including rayon, photographic film, cellophane, nitro-cellulose and plastic materials.

One of the major paper products today is paper-board, used largely for making cartons and corrugated wrapping board. The production of board in the United States in 1953 was nearly 13 million tons, and was equal in amount to all other paper products combined. Much of it is made from used and waste paper, so that it does not represent a serious drain on forests.

**Forest and timber conservation.** One of the great problems of countries which have and use enormous amounts of timber is to ensure adequate forest resources for all time. In Canada, where 95 per cent of the forest land is Government-owned, the initiation and execution of forest conservation programmes is relatively simple and a full programme of forest research and forest management is in operation. The basic features of any forest management programme are first, to control cutting so that the amount of timber cut is less than the calculated annual growth rate of the forests; secondly, to protect the forests from destruction by fire, disease or insects; and thirdly, to set about planting trees where past forest cutting has destroyed them on areas prone to soil erosion. Canada is now actively carrying out all three phases of forestry control and by 1960 hopes to have the forest wastage covered by forest regeneration. From that time forest management merely becomes another form of crop farming.

There is a very different situation in the United States, where most of the forest land was privately owned and the Government has little power to enforce conservation practices on private owners. In 1891 the Government began to acquire permanent forest lands in the hope that it would ultimately control enough forest to be able to follow the Canadian example. To date (1954) about 20 per cent of the forest lands have passed into Federal Government ownership and have been placed under a balanced cutting and growth economy. Elsewhere the private owners are still cutting their timber greatly in excess of the growth rate in their forests. Such a state of affairs could ultimately create grave problems in timber and paper industries of the United States.

## EXERCISES

1. **Vocabulary words and phrases:** chaparral, coniferous, steppes, prairies, lichens, sequoia, spruce, pit props, rosin, resin.

2. Compare and contrast the vegetation and lumbering industry of north-west U.S.A. and British Columbia with that of the St Lawrence Valley and the New England States.

3. By means of a base map and traced outlines to superimpose over it (as in question 2, page 240) relate the vegetation of North America to the soils and climate.

4. Describe generally the lumbering industry and its associated industries in Canada and the United States.

# CHAPTER XXVI

# LAND USE IN NORTH AMERICA

Figure 83 shows the general pattern of lumbering, hunting, farming and agricultural land use in North America. It must not be thought to be a complete picture of the use of the land in a continent where the majority of people live in cities and engage in industrial, commercial, transport and governmental activities. The total area of land occupied by cities and transport routes is considerable, but it is not possible to show it on a map like that of Figure 83. The discussion of city occupations will form part of a later section.

Before examining the various occupational activities shown on Figure 83 it will help us understand the pattern if we compare this map with the maps of climatic regions (Figure 77), soils (Figure 79), and vegetation (Figure 81), as well as the landform maps (Figures 58 and 59).

**1. Land use and cultural levels.** The general potentiality of any area for farming development is closely related to its landforms, climate and soils, and the pattern of farming types can be appreciated only by knowing the general interaction of these three natural environmental factors. Mere favourable natural factors do not of necessity create prosperous agricultural and grazing regions. If they did, the Red Indians would not have remained buffalo hunters, river fishermen and simple subsistence farmers in the same region of the mid-west of the United States, where today lives one of the most progressive and prosperous farming people on earth. The ability to use natural factors depends on the cultural level and technical development of a people. European peoples, at a much higher technological and cultural level than the Indians, were able to make a much fuller use of the natural resources of the American continent than the native inhabitants had ever dreamt possible.

**2. The importance of transport.** Another important factor in the development of farmlands is the general level and pattern of transport routes. The higher cultural and technological standard of European peoples has led to the development of manufacturing cities to produce the many processed goods they require. These cities send forth demands to the country, that is, to the farmers, to produce foodstuffs for the city dwellers and plant and animal raw materials for many of the city's factories. Movement of these raw materials and foodstuffs necessitates the construction of ample and efficient transport routes, usually railways and roads, though canals and rivers sometimes play a noteworthy part. These transport routes carry the produce of the farms to the cities and on the return

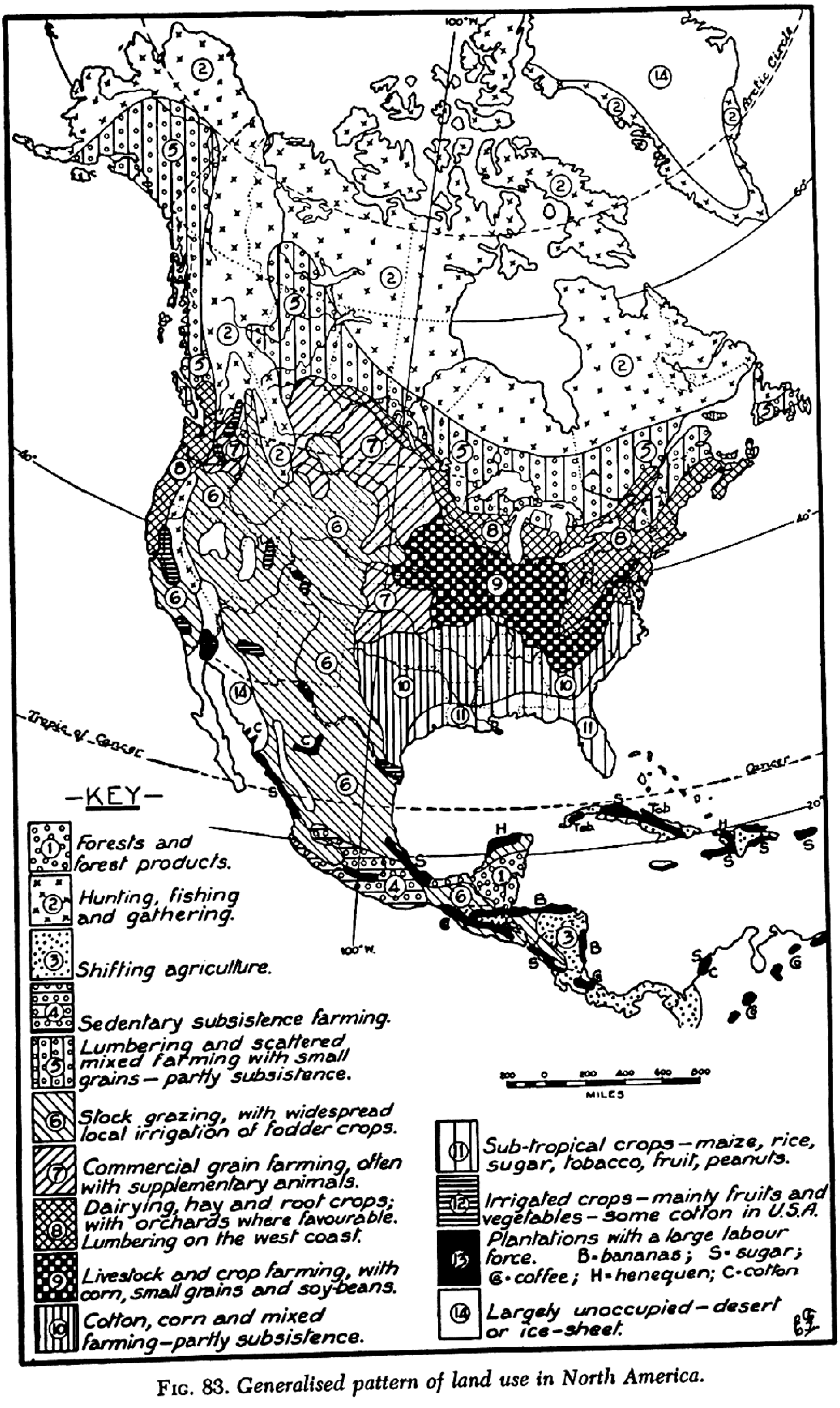


FIG. 83. *Generalised pattern of land use in North America.*

trips bring the manufactured goods from the factories to the farms. Thus the full development of farmlands is closely linked with the spread of transport routes over the farming areas. In many cases, for example, on the Canadian Prairies, the transport routes preceded the farmers. Until railways were built to these distant prairie lands they remained the grassland home of the bison and the adopted home of the cattleman. The railway converted them into one of the greatest wheat-farming areas on earth.

**3. General features of the land use map.**

(*a*) *General divisions.* As a result of the basic landform pattern of western highlands and eastern lowlands the land use map may be divided rather simply into two main sub-regions: (*i*) an area of grazing, lumbering and valley irrigation on the west; (*ii*) a region of agricultural farming on the east from the Gulf of Mexico to the southern slopes of the Laurentian uplands, where general barrenness and approach of Arctic climatic conditions precludes all agriculture. The climate of the continent is such that constant cold makes all farming impossible beyond latitude 55°N. except in certain favoured areas where a short warm summer allows some quick-maturing crops to be grown; but these are so scattered and in such small amounts that they are not shown on Figure 83. In the eastern half of Canada and the United States the steadily decreasing temperatures give a series of parallel climatic zones with ever-lengthening winters and ever-shortening summers. These were discussed when dealing with Figure 77, and their general effect on land use may be seen here.

(*b*) *The Gulf Plains.* On the Gulf Plains where the growing season is year-long (with a danger of cold waves in winter) a mixed-farming economy has developed depending on the tropical crops of sugar-cane and rice and warm climate crops such as tobacco, peanuts, maize and many fruits. To the south, in the Caribbean area and the Central American and Mexican lowlands, bananas, sugar-cane, cacao and cotton are grown, with much coffee on the better-drained slopes of nearby uplands.

(*c*) *The cotton belt.* North of the Gulf Plains, and with its northern boundary determined by the seven-month frost-free isopleth, lies the cotton belt. Here cotton is the dominant commercial crop, but the area also produces large amounts of maize (as a food for the Negro peoples), peanuts, alfalfa and small grains (varying from barley in the east through wheat to millets and sorghum in the west). A recent agricultural revolution has taken place throughout much of this area. It has witnessed the commencement of diversified rotational farming to replace the old monocultural cotton farms, with the introduction of pig and beef cattle raising into the farming economy. This was done in an endeavour to lessen the dependence of the farmers there on cotton and to help in the restoration of soil fertility and soil structure by introducing the growth of leguminous crops into the farm routine. There is now some hope that

this badly eroded land, with its depleted soils, will once again become a fertile and prosperous farming region.

(*d*) *The corn belt.* The next northward zone is the corn belt, the centre of which occupies the rich mid-west prairie lands of the Mississippi Basin (see Number 9 on Figure 83). This belt lies between the five-month and seven-month frost-free isopleths and is an area of intensive livestock- and crop-farming. Here the farms are medium-sized blocks of an average 160 acres and are subdivided into four of five sections to allow for the rotational cultivation of corn, a legume (alfalfa or soy beans), a small grain (oats, barley or wheat), and pasture grasses (clovers and Timothy hay). The whole of the farming processes are highly mechanised, and the fodder crops, hay and grains produced are partly sold and partly stored in huge silos and barns to be used for hand feeding the stock during the cold winter months. These are primarily animal-fattening farms with pigs (swine or hogs, as they are called in America) and beef cattle as the main meat animals. Poultry raising both for meat (chicken) and eggs is of great significance. Related to the farms and dotted throughout the belt are huge meat-killing, processing and packing works. The demands of the mechanically and electrically minded farming population have in turn created large industrial centres such as Chicago, St Louis, Cincinnati, Omaha and Indianopolis.

An extension eastward of the corn-growing lands passes into the largely subsistence farming lands of the southern Appalachians, where corn is cultivated mainly as a food crop for the rather primitive farmers of this area. Westwards the corn belt passes into the great Kansas winter-wheat belt, since the rainfall, while remaining ample for wheat, becomes too scanty for maize.

(*e*) *The dairying, orcharding and hay belt.* On the northern margin of the corn belt, on the remaining strip of grey-brown forest soils, is a region with a climate too cold to ripen corn but excellent for hay and small grains (including corn), which are grown to be used as green feed and ensilage. The same moist cool climate also favours the growing of pome fruits and berries. This is the principal dairy-farming, orcharding, and potato-growing region of North America. The farms are small and efficiently managed, with every possible mechanical aid for growing the crops, cutting and storing the hay and ensilage and milking the cows. The end-products are whole milk for city use in the industrial east and butter, cheese and milk powder from the less densely settled areas east and west of Lake Michigan (see Number 8 area on Figure 83). A tongue of this mixed-farming belt runs along the northern edge of the great Canadian wheat belt.

(*f*) *The spring wheat belt.* West and north-west of the corn belt lies the spring wheat belt of northern United States and the Canadian Prairies. Here are rich prairie soils and chernozems, and the spring and summer climate is almost ideal for growing quick-maturing spring wheats. The

open flat land has assisted in the development of the railway network needed to collect the wheat and carry it to shipping points on Lake Superior, whence it moves either to the eastern city markets or through Atlantic seaboard ports to oversea (mainly European) markets.

(*g*) *The Laurentian Plateau.* The northern boundary of the dairying and the spring wheat belts corresponds generally with the southern edge of the podsol zone associated with the Laurentian Plateau. Agricultural farming now ceases, except for small scattered patches in forest clearings, and the forest industries appear. Lumbering, especially for paper-pulp timber, trapping and mining are now the principal occupations until in turn, as the climatic conditions become more Arctic in character, these give way to the subsistence living of the Eskimo, based on fishing, hunting and gathering. Beyond this lies the uninhabited ice cap of Greenland and several of the island archipelagos to the north of Canada.

The eastern half of the continent has therefore shown a steady succession of zones of land use very closely related to the climate zones and the soil regions.

Figure 84 is a transect diagram showing the general succession of agricultural belts across the United States from the Gulf to the Canadian border. It also relates the agricultural practices to the climate, soils and original vegetation cover of the land.

(*h*) *Western mountain and plateau lands.* In the west the irregular pattern of mountains, high plains, plateaux, basins and valley plains results in an equally complicated pattern of human activities and land use.

In the colder and wetter north we find a continuation of the forests, with lumbering as the major activity in British Columbia and the Pacific States of the United States (Numbers 5 and 8 on Figure 83). Along the valley floors of coastal streams, such as the Fraser, Columbia and Willamette rivers there has been considerable development of orcharding, dairying and vegetable growing to supply local city populations and the eastern markets.

Over much of the High Plains and the included basins and plateaux, grazing of beef cattle and wool sheep is the principal, often the only, occupation. This is a large-scale farming operation, but the haphazard methods of open-range grazing, where the animals depended only on natural pastures, has long since passed. Nowadays much of the time of cowboys is taken in planting, irrigating and harvesting crops of lucerne, clover and meadow grasses (e.g., Timothy) and storing the resultant hay in huge barns to be used as winter feed for the stock. These fodder crops are grown on the small patches of river flats and flood plains (river bottoms) that occur along the sides of the many mature creeks and streams throughout the highland area. In general the beef cattle are more important on the High Plains and the merino and other wool sheep on the drier included plateaux and basins.

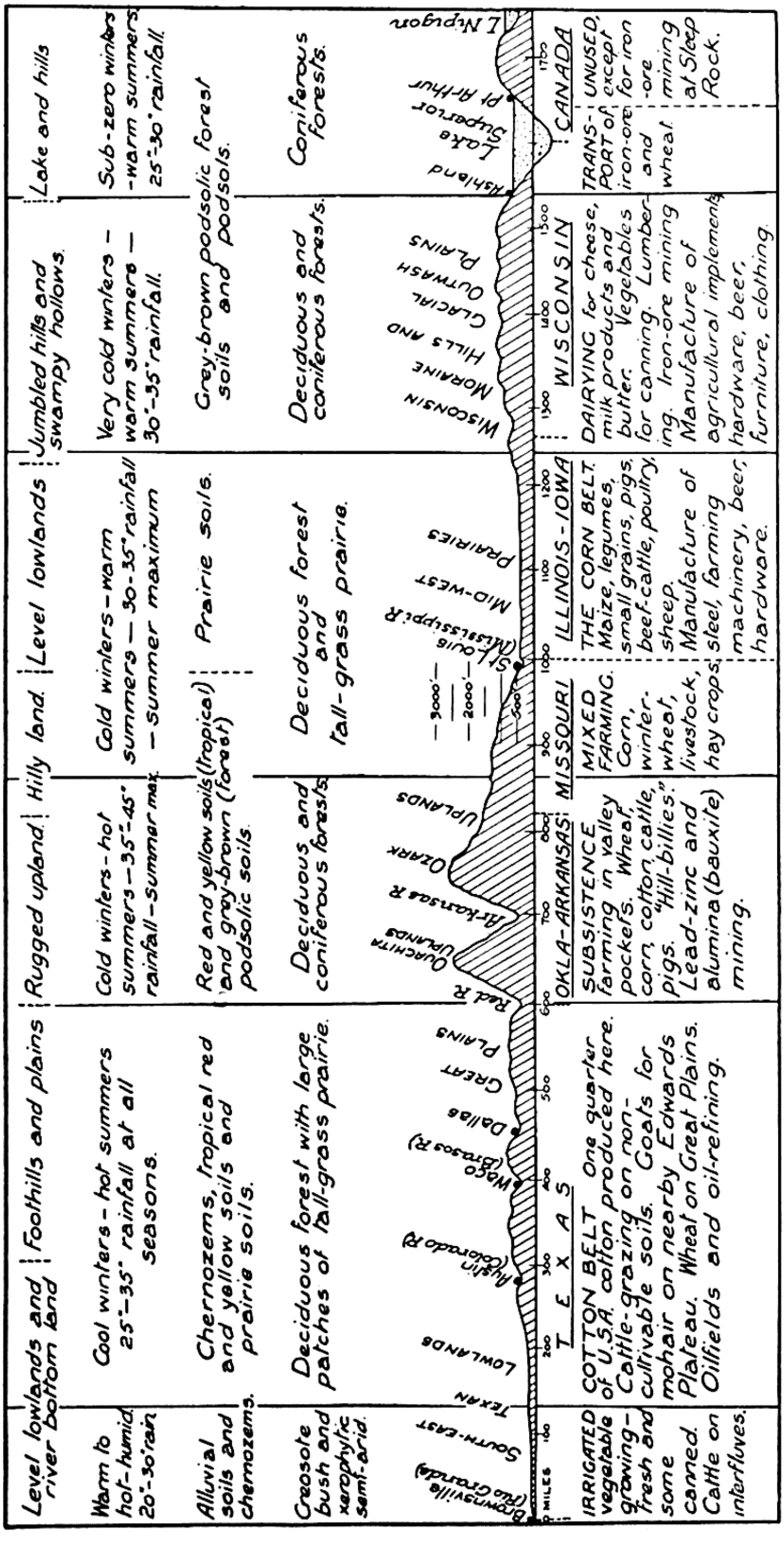


FIG. 84. Transect across the inland plains of North America from Brownsville (Texas) to Lake Nipigon (Canada).

The many snow-fed streams rising in the surrounding mountains have encouraged the storing of water and the development of irrigation areas on suitable land downstream. Figure 83 (Number 6 region) shows the location of some of the more important areas, such as Grand Coulee, Utah, Colorado, Gila River and Imperial Valley, but there are dozens of smaller areas not indicated. On these irrigated lands specialised farming is practised to produce sugar-beet, orchard crops, dates, cotton and vegetables according to the general dictates of hot or cold climates.

This grazing-irrigated farming land continues south into the heart of Mexico, but the development of farming there is generally neither so intensive nor so modern as in the United States.

(*i*) *The west coast.* On the west coast the Valley of California represents what is probably the greatest single area of river control and irrigation farming development in the world. The general features of the geography of this valley were discussed in Volume 1, *People and Place* (pages 84-7) and its river control is mentioned later (Chapter XXVII). It is sufficient to note here that over two million acres of irrigated land support thousands of farmers and produce vast quantities of crops for the eastern markets as well as for local urban groups. The area also supports the most important canning industry in America.

(*j*) *Middle America.* Central America and the West Indies have two widely separated forms of land use. At one end of the scale is the simple subsistence farming of the native Indian peoples and at the other the highly organised and efficiently managed plantations. In Central America the banana is king; but in the West Indies sugar becomes the ruler of the lives of a large percentage of the farming peoples. This juxtaposition of primitive farming peoples and modern plantation agriculture affords one of the interesting contrasts of tropical lands.

(*k*) *Farm labour.* When studying the matter of the farm labour force throughout the whole area of farming lands we find three main types or patterns:

(*i*) Much of the farming is individualistic in that the farmer and his family do the whole of the farm work with the aid of machinery. This is the case throughout areas numbered 8, 9, 10, 11 on Figure 83 and on many farms in areas 6 and 7. Also the subsistence farming of the tropical lands (numbers 3 and 4) is partly individualistic and partly tribal. The tribal groups are small and the farming is carried out by the whole tribe doing heavy work such as clearing and preparing the ground and harvesting the crops, while the individual farmers do most of the crop cultivation on their particular plots. Where irrigation is used it becomes a tribal matter to build the channels.

(*ii*) On many farms in the irrigated areas, the wheat-growing lands and the orcharding country, the farmer does most of the work himself but employs large numbers of casual workers at harvesting time and sometimes at planting time.

(*iii*) Plantations and some larger cattle ranches are run by employing a large permanent labour force. Whereas other forms of farming use considerable but varying amounts of machinery, most of the work on plantations is done by hand. Nearly all plantations also have some form of processing factory to treat the products of the land before they are exported, and these processing factories employ many hands, often seasonally.

Lumbering also uses a large labour force which is partly seasonal and partly permanent. Modern saw-millers also use a great deal of machinery to bring the logs to the mill after they have been felled, trimmed and cut into lengths by other (portable) machinery.

## EXERCISES

1. **Vocabulary words and phrases:** diversified rotational farming, monocultural farming, isopleth, open-range grazing, individualistic farming.

2. Using suitable reference books from your library, and taking North America as an example, discuss the significance of rail transport in the development of commercial grain-farming lands.

3. Examine the statement that, "The development of well organised agricultural regions is closely dependent on the cultural level of the people occupying them."

4. "In any modern community the cities and the farming areas are two closely related and interdependent entities." Discuss this statement using examples from various countries that you have studied.

5. Figure 83 is a rather detailed reference map of the land-use regions of North America. Using it to guide you draw a more general land-use map. You could start by using the main divisions of lumbering, primitive subsistence occupations, grazing, arable farming and unoccupied land. Then make what further subdivisions you deem necessary. Write a short note to justify the selection of the regions shown on your map.

(*NOTE: You should endeavour to work out simple regional patterns for all main phases of the geography of the continents you study. You will find it very helpful in sorting out the mass of material you have to study in this course.*)

6. Write an essay illustrated with appropriate maps and transect sections on the development of the Valley of California.

7. Using Figure 84 as a guide, draw detailed transect diagrams along the following lines across North America:
   (a) the 40th parallel of latitude; (b) the 50th parallel of latitude;
   (c) the 33rd parallel of latitude; (d) from Miami (Florida) to Vancouver (B.C.);
   (e) from Port Arthur (Ont.) to Baltimore (Md.); from Los Angeles to Winnipeg.

8. Using the introduction to *North America* by Jones and Bryan, or any other suitable history, write an account of the main stages in the European settlement of North America. In your answer note carefully how natural factors helped to determine the patterns of development.

9. Compare and contrast the cotton belt and the corn belt of the United States in respect to relief, soils, economic development and farming routine. (You will find *The Rural Scene* by Ford and Rowe very helpful here.)

10. What are the main features which have helped to make the land south and south-west of Chicago the greatest meat-producing region in the world?

# CHAPTER XXVII

# CONSERVATION OF NATURAL RESOURCES

## General Features

The general discussion on vegetation, lumbering, and land use in North America has shown the very full use man has made of the natural resources of that continent. With this use there has also been some abuse, which has resulted in deterioration, especially of the resources of soils and vegetation. We now examine something of this matter of resources and their proper management.

Nature has endowed all lands, especially continental lands, with a great variety of the natural resources of soil, water, vegetation, wild life and minerals. The use and conservation of minerals will be treated separately as they occur under the surface of the earth and bear no relationship to the other resources.

In their original state there is a perfect and delicate balance of the resources of soil, vegetation, wild life and water. This is a balance very closely related to the climate and the landforms of each part of any continent; and it has been achieved over a long time. In order to live man must make use of the resources of Nature. While he was still in a primitive stage of development his use resulted in very little harm being done to them. He was really one of the forms of wild life whose infrequent damaging efforts (such as firing grasslands to drive out the game) were on a small scale and easily repaired by natural agencies. With the steady growth of civilisation came a greater knowledge of ways to develop natural resources and bend them to his will. Greater technological skill, coming with the increase in knowledge, gave man added weapons with which to attack the rest of Nature. The agriculturalist now found the need to remove the trees of the forests to make way for his farmed lands, and the grazier concentrated his herds and flocks in great numbers on the available grasslands—numbers often far greater than the land was intended to carry. Elsewhere arable farmers ploughed up the grasslands to grow grain, and, after harvesting the crops, left the exposed surface for the destructive forces of wind and water to damage at will.

With the coming of the Machine Age and the subsequent crowding of populations into cities, even greater demands were made on the land and its resources. The tremendous increase in the population of the world—from about 660 million in 1750 to nearly 2500 million today—has resulted in (*a*) a far greater and more intensive use of the resources of the older settled lands of Eurasia; and (*b*) an expansion into the newer lands of America, Africa and Australasia, where there was originally a great abund-

ance of untapped resources. This abundance has been a fruitful cause of rapid destruction, especially of forests, wild life and minerals. And with the forest destruction there was initiated a slow but cumulative phase of soil and water deterioration. In the early developmental days in each of the newer continents there was apparently no need to worry about conservation; Nature, it seemed, had provided such huge reserves of good soil, great forests and running streams that there was no discernible need for the incoming settlers to worry if their farms fell away after a decade or so of use. There was plenty more land and if the forests near the centres of settlement were exhausted there was so much timber elsewhere that man could never use it up. This easy-going and thoughtless use of resources continued throughout the nineteenth century at an ever-increasing tempo. It was not until the present century that thoughtful and observant scientists, who had noted the terrible waste of resource material, became sufficiently numerous to make their warnings heard. Now, all educated peoples are more or less aware of the awful damage done during two centuries of destructive use and of the need to change the methods of land use so that resources may be used and still be there for use by future generations.

In no continent has the abuse of resource material been greater than in North America, for it was here that Nature was most lavish in the apportionment of natural resources. Also, North America was the nearest undeveloped land to western Europe, where the modern industrial and machine era started; so it received the first onslaught of the new pioneers seeking land to develop to supply the factories and people of the rapidly expanding industrial towns of Europe. It was here that the modern idea of conservation of resources possibly had its development, and it is certainly in North America, and particularly in the United States, that the practices of conservation have been applied most widely and in the greatest variety of ways.

Today, conservation aims broadly at: (*a*) the correct and most economic use of those natural resources which are *expendable* as, for example, the minerals; (*b*) the substitution of sound methods of control and the introduction of wise means of use for those resources *which may be totally destroyed but can be restored*, as, for example, forests, wild life and soils; (*c*) the use, where possible, of *inexhaustible resources* in place of those which are expendable and non-restorable, e.g., water power for generating electricity in place of coal or oil power, and the use of plastics, made from plant substances, in place of metals.

### Methods of Conservation

**1. Forests.** In the great triad of soils, plants and water, the plants, especially the trees, must be regarded as the keystone. Vegetation checks erosion in several ways. Its root systems have a physical action in binding the soil and protecting it from running water. The forest litter acts as a

protection to the soil and as a sponge to hold rain, which is released for long after the rain has ceased to fall. The decay of the litter into humus improves the general soil structure and increases its absorptive and water-holding capacity. Land covered with normal forest growth and its accompanying litter will absorb about 25 times as much rain water as similar land which has been cleared of all vegetation. This water is later released gradually into the streams which, because of the forest protection of soils, are crystal clear and abounding with fish life. The forest cover will also be able to absorb all but the very heavy flood rains, thereby lessening flood danger. The trees and litter protect the soil from the direct beating action of raindrops and the baking action of the sun's rays. Trees also protect land from the drying action of strong winds. Even in a gale which rocks the tree tops violently there is almost perfect stillness on the forest floor. Finally, the trees act as shelter for wild life and for domestic animals.

It should be apparent that to preserve our soils and the steady flow of water in the streams draining from our highlands, we should take great care of our forests. Yet of all natural resources they have suffered the greatest onslaught and damage, so that forests now present one of the world's greatest conservation problems. It has been created not only by the ruthless destruction of timber in lumbering operations, but by careless clearing and ringbarking for agricultural and grazing purposes as well as by the devastating effects of forest fires.

Most countries of the world are at present using up their timber resources at a far greater rate than Nature can replace them. Scandinavian and Russian regions are exceptions because of their enormous softwood forests, while a few countries like Germany and Japan practise re-afforestation on a scale sufficient to replace the cut timber. On the other hand, most countries, though following some conservation programme, which includes the re-planting of trees, lag far behind in replenishing or even in using existing supplies economically.

Modern methods which are usually suggested and put into operation for forest and timber conservation include:

(*a*) *Preservation*, which is the control of lumbering so that sufficient timber is always left to ensure natural re-growth.

It aims at keeping the annual cut of timber less than the amount grown by the forest. Every tree in a forest puts on a certain amount of timber increase in any year. By calculation it is therefore possible to estimate the total amount of timber increase in any forest area. When this is known it is a simple matter to keep the amount cut below this figure.

Another aspect of preservation is the control of natural regeneration of trees within the forest areas; establishing new trees by natural regeneration is much more satisfactory than planting. The trees are allowed to seed and the seedlings are thinned out to the desired spacing and then protected as far as possible from pests (such as the rabbit) and destruction

by fire. By this method of control young trees are always replacing those removed by lumbering.

(*b*) *Fire control* implies adequate control and protection against the catastrophic effects of forest fires. Here there is not only an actual loss in timber and plant life but a resultant exposure of young growth and consequent killing off by winds and frosts. There is also a diminution of bird and other wild life, water and wind erosion on the exposed topsoil, and the destruction of beauty spots. Elaborate services of aerial spotting and trained rangers are provided in many great forest regions today, particularly in the United States. The building of access roads in forest areas to enable fires to be quickly attacked and localised is an important feature of fire control.

(*c*) *Re-afforestation*, which is the replanting of suitable forest trees in selected areas. This may take two forms. First, there is the practice of the planting of natural species of trees in suitable places, more particularly on deforested watersheds and catchment areas. Secondly, there is "beneficiation", or the planting of exotic species where there is a shortage and where climate and soils will permit.

(*d*) *Administration*, or the Government control of forests. This refers not only to the proper supervision of forest resources by skilled State experts, but the establishment of new timber areas along the lines suggested above. Such administration is typical of most countries today. In Australia each State has its own special department for forest administration and men are recruited for special training in forestry before entering it.

(*e*) *Milling*, with improved cutting operations. These aim at enforcing milling operations which will reduce waste and make the best possible use of poorer timber trees (e.g., to produce masonite or paper-boards).

(*f*) *Research*, which embraces the further study of forests and timber for their most effective use. There is still a big field for research in many branches of the science of silviculture, e.g., the growth and use of timbers and the study and control of tree-diseases. In Australia the growth of native cedar, a most valuable and beautiful cabinet timber, is still hampered by destructive diseases.

(*g*) *Substitutes*, which means the using of other plant products for timber in various constructional works. In recent years there have been great advances made in the manufacture and use of different types of pulpwoods for boards. Masonite, a wide variety of veneers, and the use of sugar-cane fibre (or caneite) have done much to save forest timber in housing and furniture making.

**2. Grasslands.** These important natural resources are now receiving attention in the study of conservation problems, both in their relation to pastoral agriculture and in the preservation of soil cover. As a result the following are some of the important controls adopted:

(*a*) *Prevention of overgrazing.* This is a difficult task for Government authorities, as it involves so many properties belonging to private individuals. The general procedure is to offer free advice and suggestions by experts and to give wide publicity to the possible losses which may be entailed in the future on overgrazed lands. An extreme measure is to introduce legislation compelling "retirement" of certain lands. This step was taken in the United States in a desperate attempt to rehabilitate the cattle areas of its badly eroded western cattle regions.

(*b*) *Restriction of cultivation.* This can be suggested or even enforced, more especially on types of marginal lands as mentioned above. The tragedies of the "dust-bowls" can be attributed to the wholesale opening up of natural grasslands for wheat-farming in central and western United States of America and Canada and their subsequent exploitation over the years. Similar conditions have come to pass on a smaller scale in parts of our own mid-western New South Wales (Hillston area).

(*c*) *Improvements to grasses.* These improvements may take the form of re-seeding and top-dressing of areas or of using irrigation where practicable to aid the growth of natural and introduced pastures. The former poses the problem of finance for the farmer, but the latter can be achieved by Government schemes like those in the Murray Valley. Payment to farmers, on a limited scale, for pasture re-seeding and improvement is also done in the United States.

**3. The special case of arid lands.** Arid lands include all areas with a rainfall below 15 inches a year in inter-tropical areas and below 10 inches a year in middle latitudes. In practically every case this low rainfall is more or less erratic in its occurrence and long drought periods are common. These are desert marginal lands and as such often have desert conditions thrust on them. The vegetation cover under such conditions includes several distinct types:

(*a*) *Trees* which grow singly at spaced intervals, or in clumps, or in straggling lines along watercourses. Some of these, like the Australian mulga and kurrajong, are good fodder for stock.

(*b*) *Shrubs*, among which may be noted the sagebush and creosote bush of America and the saltbush, blue bush, cotton bush and indigo bush of Australia. Many of these are excellent stock fodder; but because of their slow regeneration after being eaten they must be grazed with care.

(*c*) *Tuft grasses* such as spear grass and wire grass. These are good fodder when green but are mostly unpalatable when they dry off.

(*d*) *Herbage plants*, which are the ephemerals that appear in extraordinary abundance after good rains pass over the arid lands.

The basic fodder of these lands consists of shrubs and tuft grasses. The abundance of good edible shrubs led early settlers to overstock. They did not appreciate the slow recovery rate of the plants and tended to

stock their properties up to the number that could be carried by the virgin bush. The result was the virtual elimination of many of the good fodder plants from vast areas of arid grazing lands.

Correct grazing methods in these lands include:

(*a*) The *stocking* of the property within the limits determined to be the safe carrying capacity of the area—usually one sheep to 10 acres or more and one beef cow to about 100 acres.

(*b*) The *subdivision* of the huge properties required into paddocks of five to eight square miles in area, with the provision of centrally placed drinking dams. This allows for a uniform grazing over the whole paddock.

(*c*) The introduction of *rotational grazing* so that the shrubs may have from two to three years to recover after being grazed. This would necessitate anything up to 20 or more subdivision paddocks with their watering places.

(*d*) The construction of *large water storages* so that they will hold sufficient water to last through a two-year drought in an area where the evaporation rate often exceeds 100 inches a year. If possible some dams should be used to irrigate (preferably by spray irrigation) small paddocks of a few acres in area of lucerne or a clover-meadow grass mixed pasture. The crops so grown would be cut and stacked as hay for use in drought years.

(*e*) Where overgrazing has severely damaged the vegetation, *pasture furrows* on the contour should be cut. Perhaps a chisel-plough is best for this as it allows water to penetrate to the subsoil without turning the sod over like an ordinary plough. On level land denuded of vegetation by overgrazing a checkerboard pattern of chisel-ripped furrows gives the best result. The restoration of the vegetation by natural regeneration is quite rapid once the furrows have been ripped in order to collect blowing seed and to allow for moisture absorption into the soil.

(*f*) The *eradication of pests* like the rabbit, for they consume great quantities of grass and herbage and mostly negate attempts to rehabilitate worn-out pasture land. Myxomatosis has achieved wonders in Australia, but rabbits will reappear as a menace in a decade or so unless farmers carry on a constant warfare against them by poisoning, digging out their burrows and netting the paddock tanks in dry years.

The arid lands are difficult regions offering a challenge to man in his attempts to use them. With care and with the aid of science, particularly agricultural science, the farmer can use them profitably and permanently.

**4. The conservation of water.** All farmers practise some form of water conservation when they build various types of storages to provide drinking water for their stock; but the general meaning of the term water conservation is much wider than this. It includes the following features:

(*a*) The *damming of streams* in well-watered highlands and the *storage* of huge volumes of water for use in irrigation projects on the flood plains of the middle and lower parts of the river.

(*b*) The use of the *power of impounded water to generate electricity* which can be transmitted to nearby cities and towns and to the farmers on their farms.

(*c*) The use of the stored water to maintain a *regular flow in the river* for purposes of navigation. This often necessitates the construction of numerous weirs and locks along the course of the river in order to keep the lower river sufficiently filled with water.

(*d*) The use of the *headwater dams to check floods*. This is achieved by building the dams with a capacity for generating power or maintaining navigable waters in the river. The top waters in the dam are theu drained off rapidly after rainstorms and the level of water is kept sufficiently below the crest level to allow the dam to take the edge off an advancing flood. Many modern dams are built along these lines.

(*e*) More recently the idea has developed of transferring water from regions of high rainfall to regions of low rainfall by *tunnelling through mountains* so that coastal streams may be diverted inland; or by building enormous *pipelines and aqueducts* to carry the water over deserts and mountains without loss. The Snowy Mountains Scheme in Australia is an example of the transfer of water from coastal streams to those inland, and the Boulder-Parker Dam and Los Angeles Pipeline affords an illustration of the transfer of water by pipelines over long distances over difficult country. The All-American Canal supplying the Imperial Valley of Lower California is another example of water transfer.

In the Valley of California a spectacular water control scheme is now operating (see *People and Place*, Figure 37, for a map to illustrate this work). The Sacramento River, draining southwards, rises in a region of high rainfall. It therefore carries a large volume of water, especially in the winter and spring, the rainy season. Only a small area of its valley floor is suitable for irrigation and at its mouth are large tidal swamp lands. Here the salt water invades the land during the summer when the river flow is low and there is insufficient river current to dam back the tides.

The San Joaquin River, draining northwards, has a small flow because it comes from an area of moderate rainfall. South of its headwaters is a large area of flat irrigable land which is almost rainless.

The first stage in the water conservation scheme of the Valley of California consisted in damming the upper San Joaquin and each of its main tributaries. The water obtained was used to irrigate the orchards which have made California famous. Some of the water from the Friant Dam and Pine Flat Reservoir on the San Joaquin and Pine Creek was carried by an aqueduct running high up the valley side to the arid southern part of the valley round Tulare and Bakersfield. This opened up an

enormous area of orchard land but diminished the flow of water to the middle and lower San Joaquin. The second stage was therefore started. This is now completed and it consisted of building the huge Shasta Dam (530 feet high) on the upper Sacramento and running water from it by canal to Tracy in the Delta area. Here enormous pumps lift the water to a high-level canal running south to Merced along the western flanks of the Valley. At Merced the Sacramento River water is run into the middle San Joaquin and thence downstream to the Bay of San Francisco. It is used for irrigation and the volume is kept at a level sufficient to stem back the flow of salt water in the Delta marshes. These are now being drained and turned into vegetable gardens. Truly a great scheme, where man bends a river to his will.

When first introduced, large-scale irrigation schemes were developed to grow mainly fruit and vegetables, which were either sold fresh or canned or dried before selling. Nowadays many large schemes are concerned with irrigating crops and pastures to allow for a greater stock population to be raised on dry lands or even to permit the introduction of an intensive mixed animal and crop farming economy on one-time grazing or wheat-growing land. Such is the case in the Riverina and Murray-Goulburn valleys of New South Wales and Victoria.

A further refinement of the crop-animal irrigated farm is that found where water-harvesting is practised. Here there are no large-scale dams and canals. Instead, the farmer in moderate (20-inch to 30-inch) rainfall areas builds sufficient dams to hold all the normal rainwater falling on his farm. This may necessitate as much as 25 per cent of his farm being flooded in perhaps six or eight dams on a property of a few hundred acres in area. The water collected is used to spray-irrigate planted clover and rye grass pastures. This can be done economically by movable spray pipelines. The irrigated pastures allow for a spectacular increase in grazing. A Sydney University farm at Badgery Creek near Liverpool (N.S.W.) increased its carrying capacity ten times by using this method of water conservation. At the same time it made possible a great improvement in the general soil fertility by allowing for the introduction of legumes that previously could not be grown.

Proper water conservation practices also envisage the stocking of streams with fish and the general prevention of stream pollution by factory effluent.

Very few countries are making the fullest use of available water supplies. In parts of the Far East man probably comes closest to achieving the full use of all available water. It is doubtful whether even the United States with its Tennessee Valley Authority and its Californian Valley Scheme comes as close to full and proper use of water as do the Java peasants on their *sawahs* (irrigated rice paddys) of the plains of north Java. In this matter of water and its full use the West can probably learn much from the East.

**5. Soil Conservation.** As we have noticed earlier in this chapter, large areas of farmland were damaged by our ancestors unwittingly practising incorrect farming methods. It is not intended here to discuss the various types of soil erosion and their causes, as this may be found out by reading any of a number of soil erosion and soil conservation journals issued by several leading Banks and by the Conservation Departments of the various Australian States. As the accompanying maps—Figures 85(a) and 85(b)—show, it is safe to say that most permanently occupied farmlands have suffered soil erosion in some degree. Modern conservation has the twofold aim of preventing further erosion and restoring the soil to its previous level of fertility, or even improving that level by better farming methods.

In England, Germany, France, the Netherlands, Denmark and Switzerland wise land use has brought the countries through many centuries of agricultural occupation. Slowly evolved conservation practices have been in operation for so long that their use is now never questioned. In fact, failure to follow the long-established safe farming routine would draw critical attention to any farmer. The countryside there presents an appearance of permanence as well as beauty. Despite continued occupation for up to 1000 years there are still large numbers of trees and woodlots dotted over the landscape. Here the tree is a corporate part of the farm and its value as a check on soil erosion and on the absorption of soil moisture is fully appreciated. The land in these countries is treated as a natural resource to be used so that it pays yearly dividends without any loss of the original capital of soil, water and trees. Figures 85(a) and (b) show something of the stark tragedy of European settlers abandoning the wise farming methods of their homelands when they settled overseas in new lands. It is very necessary that these two maps should be related to maps of agricultural land use, for then the real tragedy of erosion will be better appreciated. The further effects of soil erosion on river flow, where it silts up the channels with the waste from the eroded land and also increases the liability to more frequent sudden flooding, is not shown on the maps.

Erosion prevention is largely a matter of using land in agreement with, instead of in opposition to, Nature. Recovery of eroded land is based mainly on various means of restoring things to something approaching their condition before man abused the land.

The conservation methods for dry lands have already been discussed above. In humid areas, where there is sufficient rainfall to cause frequent run-off, the erosion control measures are different. The first step is to place the run-off under control. Destruction of the original vegetation lowered the absorptive property of the soil and hence greatly increased the run-off after heavy rain showers. Frequently the practice of ploughing land up and down the slope aided the run-off and the removal of surface soil by creating gutters along the furrows.

Checking the run-off is achieved by basing all farming practice on the

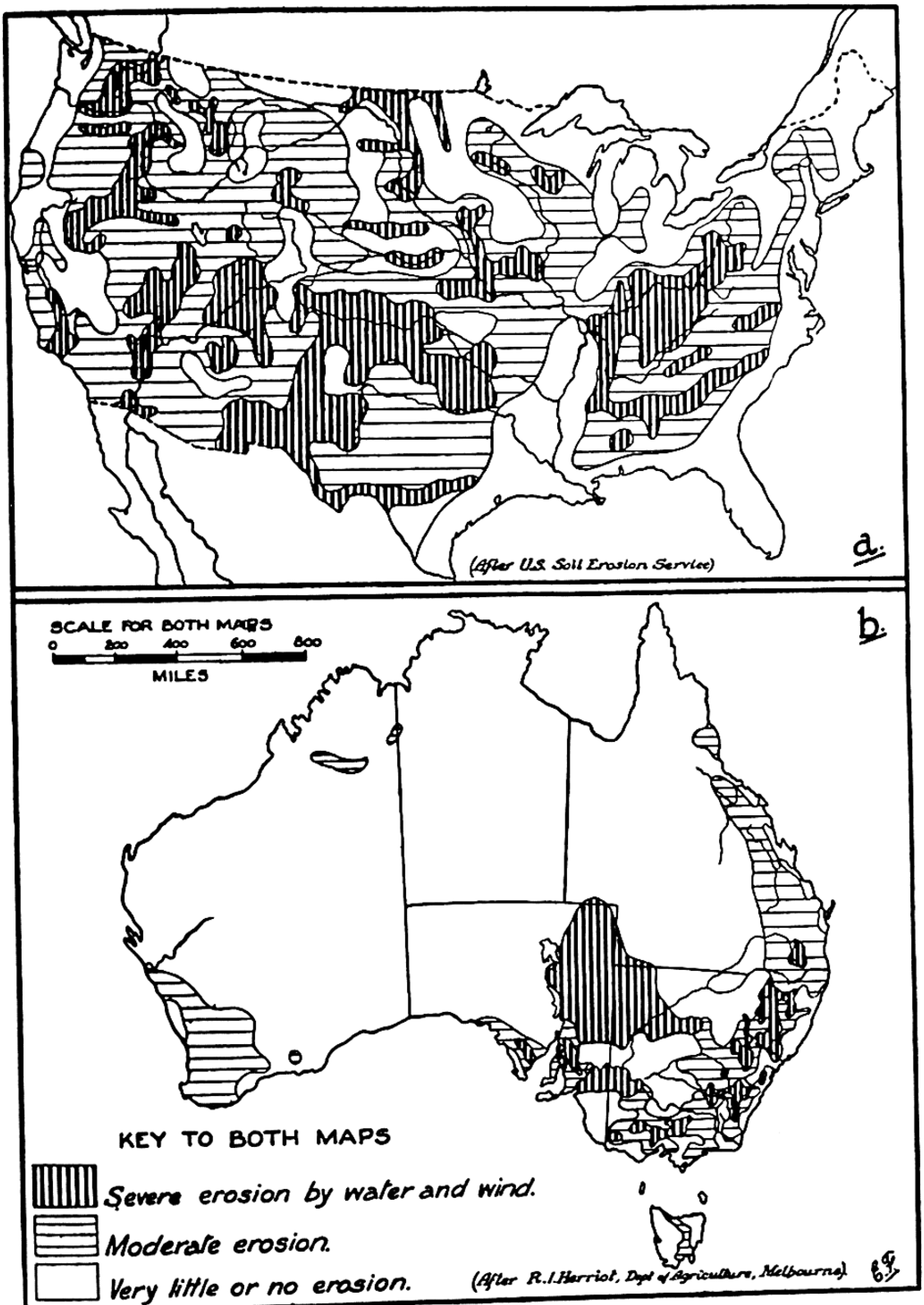


Fig. 85. *Generalised maps comparing soil erosion in the United States and Australia.*

*contour*. Furrows are ploughed along the contour so that the turned earth acts as a barrier to the run of water from the land and increases absorption to the root zone of plants. Contour drains with contour banks on

their down-slope side are added where necessary to collect excessive run-off water and conduct it along the slope to a chosen point, where it will be allowed to run down to the valley and its creek. The waterway carrying the water downhill is made broad and shallow and is planted with a thick carpet of mixed holding grasses and plants such as couch, kikuyu, clover and rye grasses.

Dams are constructed on steeper slopes to collect water and check excessive run-off and dams are also built on the lower slopes at the outlet of the grassed waterways to collect and hold water for stock drinking.

Where gullying has occurred they are filled in and stabilised by various methods; and where streams flow through the farm measures are taken to prevent erosion of the stream banks during freshes and floods.

All these methods are discussed at great length in the various pamphlets referred to earlier.

After having checked the erosion of the soil it then becomes necessary for the farmer to adopt correct conservation land management practices. This is important in order to regain soil fertility and productivity (for erosion saps that as well) and to consolidate the erosion control effected by mechanical works. Land too steep for cultivation is contour furrowed and returned to pasture or tree cover. Cultivation paddocks are put under a crop rotation scheme that includes clovers for nitrogen enrichment of the soil. The aim of all these farming methods is to maintain a protective covering on the soil, to raise soil fertility and to improve soil texture, thereby increasing water absorption and decreasing soil erosion.

The common impression that soil conservation consists merely of the construction of banks, furrows and waterways is completely wrong. It goes far beyond the mere mechanical repair of erosion-damaged lands and the installation of control measures on susceptible land. The primary control of erosion is through sound land management and thorough conservation farming. By carefully regulating grazing; by sowing improved pastures; by including temporary legume pasture in the wheat rotation—in these ways soil fertility is built up, water absorption increased and soil erosion arrested. Earthworks, or mechanical control measures, aid in the recovery of deteriorated land and assist in erosion control; but soil conservation is ultimately dependent on good farming. Wise land management must always remain the first line of defence against soil erosion.

## EXERCISES

1. **Vocabulary words and phrases:** balance in Nature, expendable, resources, restorable resources, inexhaustible resources, forest preservation, natural regeneration of forests, re-afforestation, exotic plants, silviculture, drought, rotational grazing, pasture furrows, contour ploughing, sawah.

2. Discuss the importance of correct farming practice in soil conservation.

3. Discuss the importance and manner of water conservation, using appropriate examples to illustrate your answer.

4. Discuss the role of plants and vegetation generally in the pattern of conservation of natural resources. Illustrate your answer with appropriate examples.

# CHAPTER XXVIII

# MINERALS AND MINING

## General Development of Mining in the World

Past civilisations in Egypt, Mesopotamia, India, Indonesia and the Far East were based on the work of human slaves, that is, on controlled human muscle-power; that of today is founded on the slavery of machinery in the service of man. Our progress is now linked with our ability to produce increasing quantities of better tools with which to harness and adapt the natural environment so that it may be directed towards providing more food, more raw materials and increased comforts, conveniences and power. All this development in modern times has been made possible principally by an ever-widening use of minerals. Without mineral fuels and metallic minerals and the ability to use them, man would be little better off than his Stone Age ancestors. The civilisations of Greece, China or Egypt had very high intellectual standards, but they lacked the power and the capability to gain any great material advantages from Nature. The growth of mining and the increasing dependence of civilisation on its products marks the greatest change that has ever occurred in human affairs. This change really got under way, after a long and stumbling start, during the latter half of the nineteenth century. The start was when some early tribe learned to use bronze; the present stage lies in the growing knowledge of how to use nuclear fission in the service of mankind instead of for its general destruction. Between these two indefinite dates lies the Bronze Age, the Iron Age and the Industrial Revolution, which ushered in the Steel and Machine Age between 1855 and 1875. This in turn is now developing into what might be termed the Plastic and Nuclear Age. Steel, however, is still basic to high-level civilisation throughout the world.

In physical geography a mineral is any chemical helping to form the rocks of the earth's surface. Their number is legion but we are concerned only with some of the more important metallic minerals, fuel minerals and non-metallic minerals and compounds. A brief classification of these would include:

**1. Metals.**

(*a*) General utility metals which have been in use for centuries. They are iron, copper, tin, lead, mercury and zinc.

(*b*) The light metals which have become significant in our Air Age. Aluminium (aluminum in America), magnesium and titanium are the three most widely used ones.

(*c*) Alloy metals, which are of great significance in converting iron into steel. Chromium, manganese, molybdenum, carbon, tungsten, vanadium and cobalt are some of the common ones.

(*d*) Precious metals, such as gold and silver, which have been known from the earliest times, with platinum as a recent comer.

(*e*) Nuclear fission metals, of which uranium, thorium and cobalt are at present very important.

2. **Fuels,** which includes all varieties of coals, petroleum and natural gas.

3. **Non-metallic minerals.** These include a very wide group of rock substances among which we may note sulphur; nitrates, potash and phosphates; dolomite, cryolite and magnesite (fluxes); limestone (as a flux and for making cement); kaolin; asbestos, mica, graphite and gypsum. In addition there are the quarried stones and the clays used for making building materials.

## The Use of Minerals

As indicated above, many of the common metals were known to the ancient world. Copper, tin, lead and iron were all in common use by the beginning of the Christian era, but only in small amounts. A few thousand tons a year would be the total production of all of them in these early times. In addition, the precious metals, gold and silver, were always important as a means of barter, for currency and for making ornaments and jewellery. Again, the total amount used was quite small by modern standards of production. It is doubtful whether all the gold in Egypt or Mesopotamia (Babylonia) was equal to one year's output from the mines of today. Copper was perhaps the most useful metal of the early world; it was used for making ornaments, cooking utensils and bronze.

During the Middle Ages metals became gradually more significant in the lives of the people. Iron was now outstripping the other metals in importance, mainly because of its use in warfare (armour and weapons). By A.D. 1800 iron was quite widely used throughout the world but still only in small amounts. Steel was unknown except at a few places like Damascus, Toledo and Sheffield, where the local iron ores contained, as impurities in them, the necessary alloys to make steel.

A comparison table of world production of some significant metals in 1800 and 1954 is interesting. (The figures for 1800 are estimates made by Hexner in *The International Steel Cartel.*)

| *Metal* | *A.D. 1800 Millions of tons* | *A.D. 1954 Millions of tons* |
|---|---|---|
| Iron | 0.3 | 160 |
| Steel | Nil | 215 |
| Copper | 0.02 | 2.9 |
| Lead | 0.03 | 1.8 |
| Zinc | Small | 2.0 |
| Tin | Small | 0.2 |
| Aluminium | Unknown | 2.0 |
| *Fuel* | | |
| Coal | About 20 | 1600 |
| Petroleum | Small | 600 |

This table shows clearly how coal, iron (as steel) and petroleum are the three most significant minerals in the modern industrial age.

The expansion of the use of metals was slow during the nineteenth century until several significant discoveries and inventions were made. These were:

(*a*) The invention of the railway engine and the start on railway building during the 1840s.

(*b*) The discovery of Bessemer in 1855 and Siemens-Martin in 1856 of ways to make large quantities of steel cheaply. These two processes really paved the way for the use of steel in place of the less useful iron of earlier times. The opening up of North America, with its large railway, bridge building and office building programme, created an unprecedented demand for steel. In the 1870s steel production in the world overhauled that of pig iron and wrought iron, yet the annual world total production of steel in 1875 was still a mere two million tons. By 1900 the world total steel output had increased to 28 million tons (United States, 36 per cent; Germany, 23 per cent; United Kingdom, 17 per cent; Russia, 8 per cent; France, 5 per cent. In 1930 the total was 93 million tons and the percentage production was United States, 43; Germany, 12; France, 12; United Kingdom, 8; Russia, 6; Belgium, 6; Japan, 3. Today (1954) the total is 215 million tons and the percentage production is United States, 44; U.S.S.R., 14; United Kingdom, 8; Germany 6½ (plus Saar, ½); France, 5; Belgium-Luxembourg, 4; Japan, 3; Poland, Canada, Czechoslovakia, each 1½ (Australia not quite 1 per cent).

## Some Special Features of Minerals and Mining

Although many of the more useful minerals and metal ores are spread over the earth's crust, the deposits which are rich enough to be worked commercially are both limited in extent and narrow in distribution. In fact, the rarity of large bodies of commercial minerals makes them of international concern and much sought after by the consuming countries. Figure 86 shows something of the distribution of mineral and mining areas throughout the world. It should be studied in conjunction with Figure 87, which shows the pattern of mineral supplies. Notice on both maps how the United States and U.S.S.R. have well-distributed supplies of all the essential minerals and fuels needed to build up a large industrial structure. The only other regions with such supplies are in China and Manchuria, and, on a smaller (though locally significant) scale, in eastern Australia and Transvaal. Elsewhere shortages of either fuel minerals or essential metals occur, while over much of the land areas there is a shortage of all minerals. It is interesting to note that the great industrial economy of western Europe and the lesser one in Japan were built up in spite of shortages of industrial metals—mostly non-ferrous metals in Europe and iron ore in Japan.

Not only are the deposits of the major metal ores scattered and

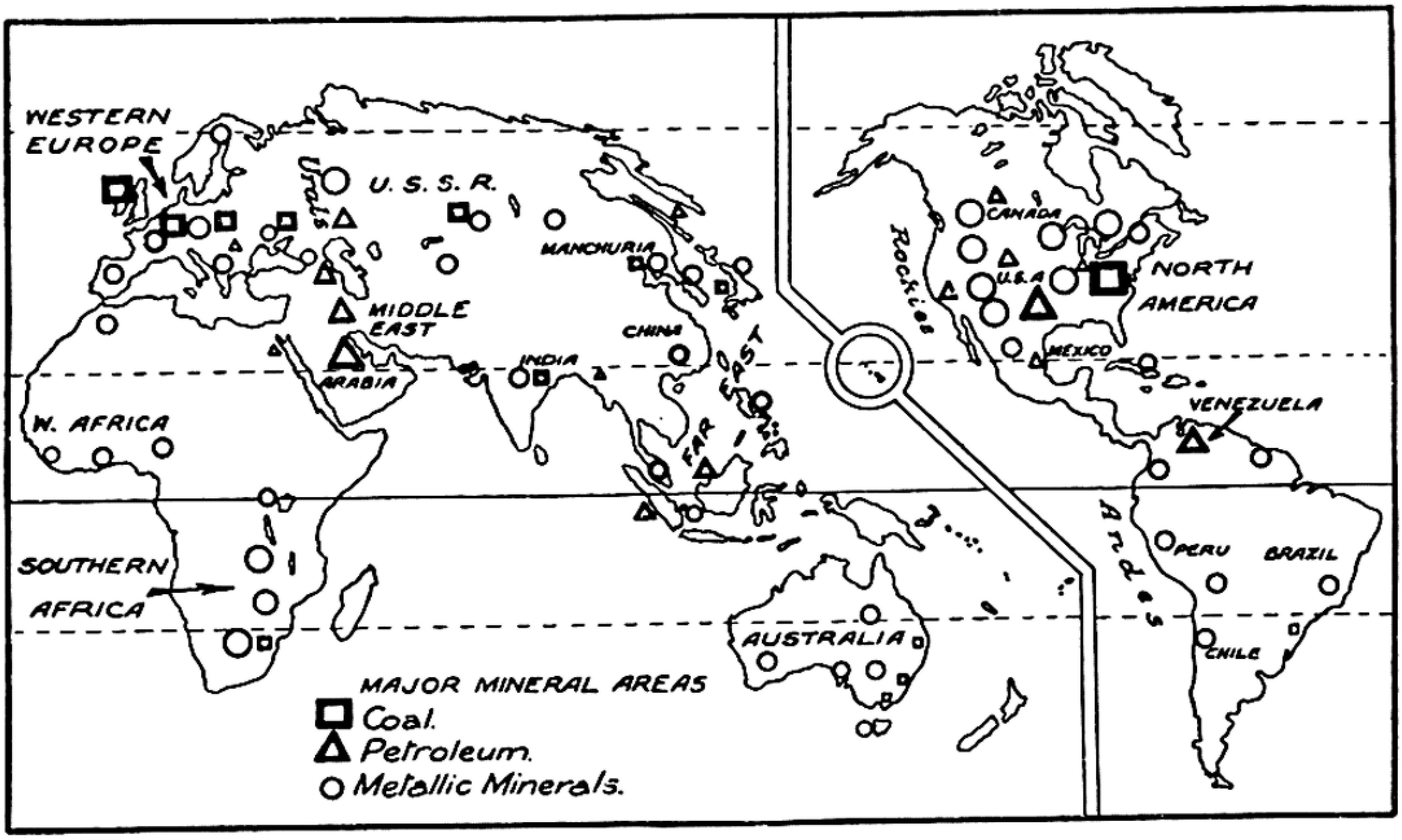


FIG. 86. *Major mineral and mining areas of the world.*

localised, but they are also mostly in rather out-of-the-way places. This makes their commercial exploitation a matter for large companies with considerable financial backing. Since the deposits are often hidden underground, their discovery is largely unpredictable. Once it depended on the luck of the prospector, but today geologists, geophysicists and radiophysicists have made the location and mapping of mineral areas a much more exact science than previously.

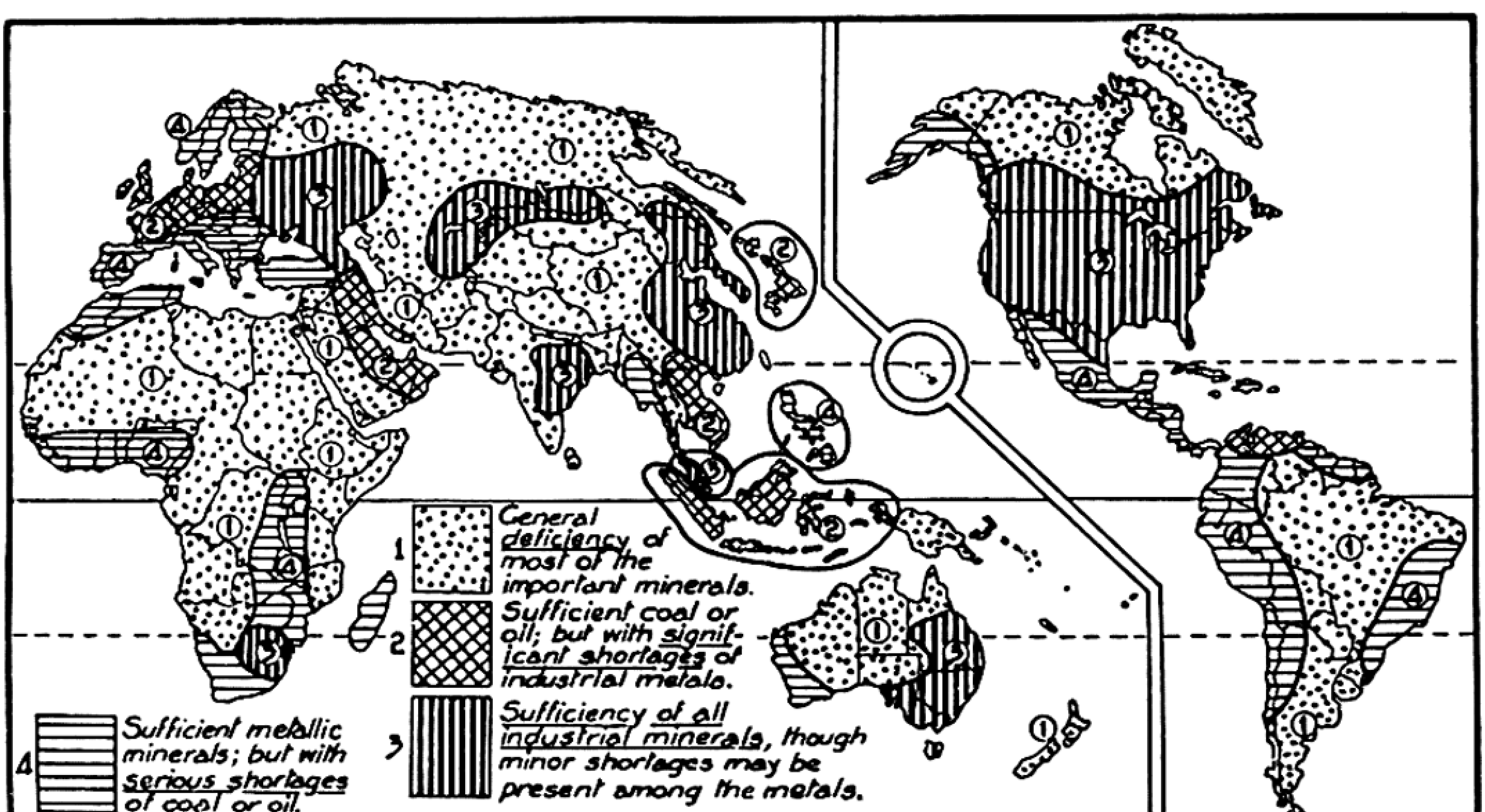


FIG. 87. *General pattern of mineral supplies throughout the world.*

Furthermore, all mineral deposits are exhaustible and most of the easily won supplies have already been mined. Only by improved technique in both mining and treatment can many of the ores be used today. To offset the possible shortage developing through exhaustion of ores it must be remembered that metals are durable and can be used over and over again. Scrap metal now plays an important part in the general use and conservation of iron, copper, aluminium, lead and several lesser metals.

A second look at Figure 86 will show that generally the fuel minerals occur in lowlands (often along the margins of adjoining highlands), while the metallic minerals are related to areas of mountain building either recent, as in the Andes or Rockies, or of past ages, as in the Urals and the Canadian shield.

Mining and movement of minerals depends on several factors. It was stated above that generally only large companies can hope to exploit metal deposits because of their general isolation, their rather low quality and the need to produce huge quantities of ore in order to get sufficient metal to meet the general demand.

Each group of minerals has its own particular method of mining and treatment. First, the fuel minerals are mined and moved in enormous amounts both by land and by sea. Coal is rarely just where it is required for industry, except in some of the older industrial centres, which were built on the coalfields. For newer industrial regions in America, Australia and the Far East the coal is often carried for quite long distances to the industries. Oil is never found in large quantities near the centres where it is used, so that practically the whole of the petroleum output is moved by pipeline and tanker to the consuming areas.

Secondly, iron ore and bauxite (aluminium ore) are found in deposits of sufficient size to be quarried. These deposits are mostly far from the consuming centres, and the ore has to be moved by ship or by rail after mining. As the present worked deposits are fairly rich (usually 40 to 60 per cent metal) the ore is moved direct from the mine to the smelting centres.

Thirdly, the ores of copper, lead-zinc, tin, nickel and the precious metals usually contain only from a few ounces up to a few pounds of metal per ton of ore. Thus a high-grade lead-zinc ore would have 10 to 12 per cent metal, while a rich copper ore may have a mere two or three per cent and a gold mine can be worked profitably with half-an-ounce of gold per ton of ore. Under these circumstances the various ores undergo preliminary enrichment at or near the mine before being shipped to the markets. This enrichment aims at removing waste and useless rock material and obtaining a chemical compound of the metal with a high percentage of the metal in it. Such ore-field concentration and smelting is common on all non-ferrous metal mining centres, though (as with Broken Hill, New South Wales, ores) the smelting is not always done at the mine; it is often more convenient and economical to have the smelters at a point accessible to coal supplies, as at Port Pirie.

Figure 88, showing the broad pattern of manufacturing regions throughout the world, may be regarded as a summary of Figures 86 and 87. It shows at a glance that coal and iron ore supplies in abundance are the prime essential for the development of large-scale and widespread manufacturing. The great development of manufactures in western Europe, north-eastern United States, and eastern Canada is due to the abundant supplies of coal and iron being utilised by a technologically advanced people with the capital and initiative to develop industries. This figure will be referred to more fully in the chapter dealing with manufacturing. It is sufficient here to retain the general pattern of manufacturing distribution as related to the supplies of minerals, as indicated especially in Figure 87.

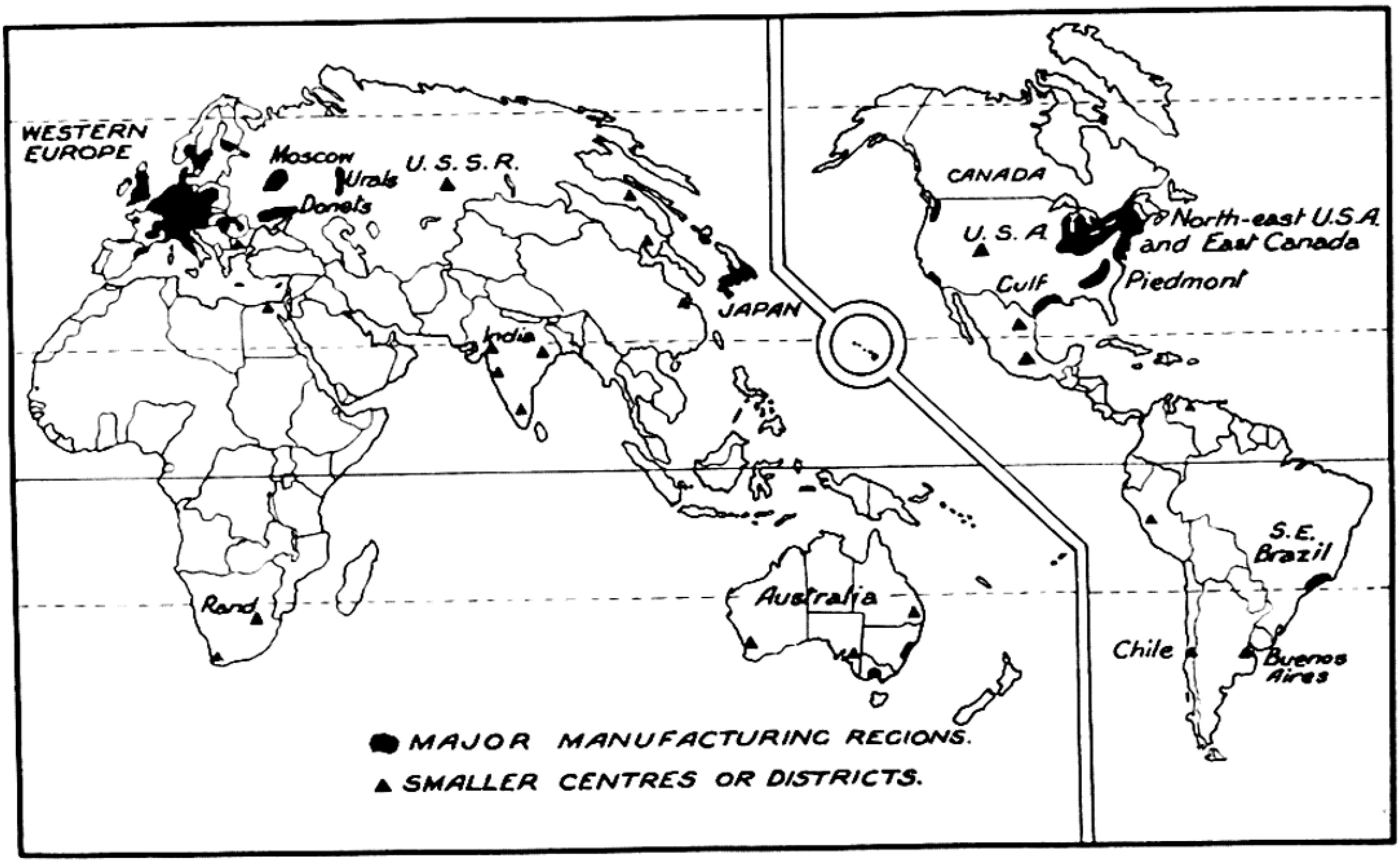


FIG. 88. *Major manufacturing areas of the world. By comparing this map with Figure 87 it is possible to relate mineral sufficiency and manufacturing development.*

## Mining and Minerals in North America

**1. General features.** Look at Figures 89, 90, 91, 92 and 93. These are a general summary of the pattern of mining and mineral areas in North America, together with a graph of production of the three basic minerals for industrial development. Figure 89 is a general summary of all mineral areas into broad sub-regions and from it we may notice the relation of minerals to landforms.

On the east are four areas linked with the Appalachian and Laurentian shield uplands. The bituminous coal (Number 1 area on Figure 89), together with small oilfields, occurs in the Alleghany Plateau and the

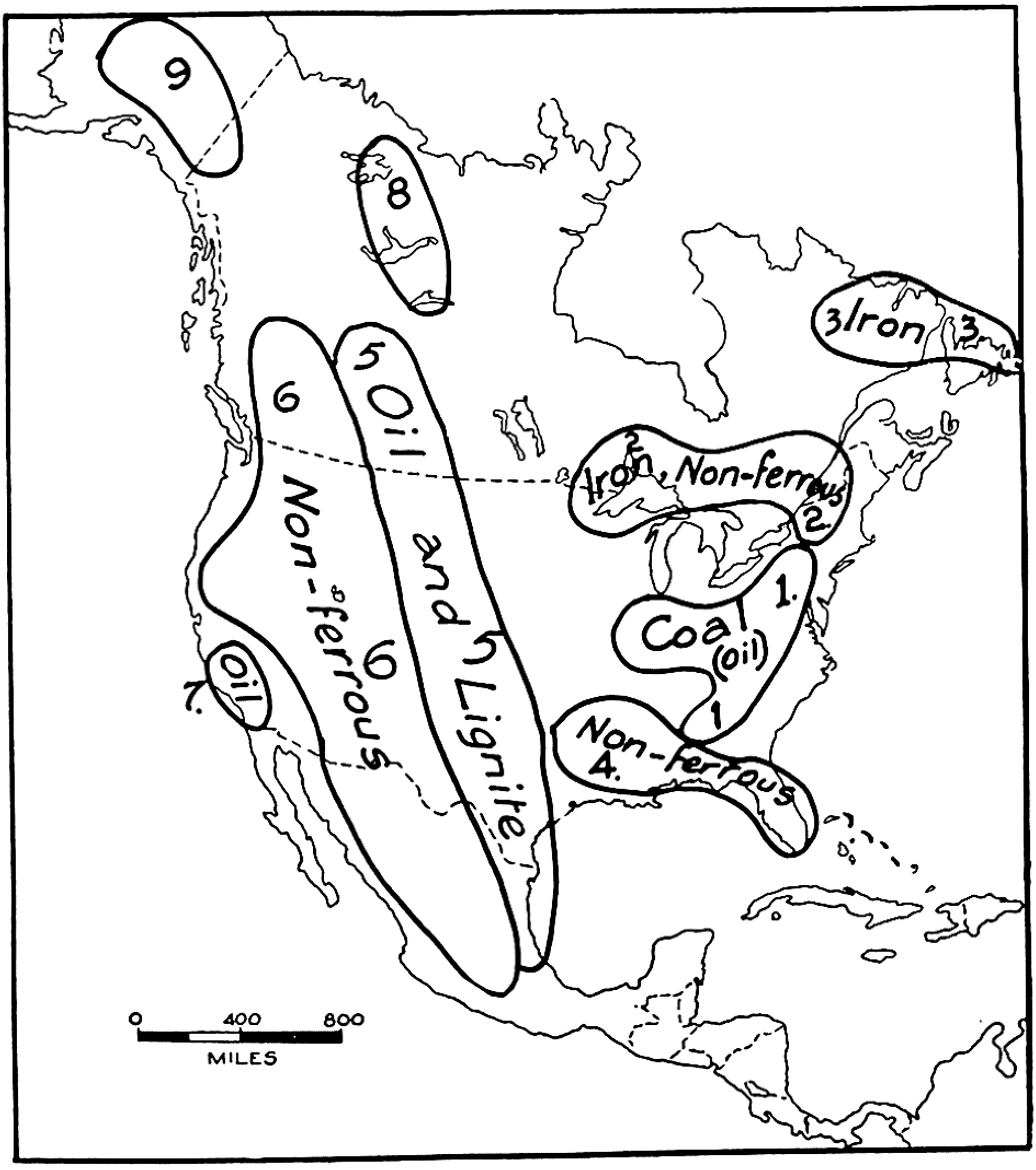


FIG. 89. *General pattern of mineral areas in North America.*

lowlands to the west of it. Northwards in the older rock areas of the Laurentian shield and the Lakes Plateau (Number 2 area) are significant deposits of iron ore and non-ferrous metals, and farther east in Newfoundland and Labrador is a second area of iron and titanium ores (Number 3 area). On the southern flanks of the Appalachians and extending from the Ozarks to Florida is a belt of non-ferrous metals and phosphates (Number 4 area). The inland plains are almost without any minerals, but on the eastern flanks of the Rockies there occurs the world's greatest known oil belt, together with (at a different geological horizon) enormous deposits of lignite and semi-bituminous coal.

In the Rockies, in the Sierra Nevada and Cascade ranges and the plateaux and basins between them, are a great number of significant

mineral deposits. Among these copper, lead-zinc, molybdenum and gold are very important.

On the western flanks of the Sierra Nevada lies another large oilfield (Number 7 on the map). Small isolated areas of non-ferrous metal production occur in Alaska (Number 9 area) and the Mackenzie Basin (Number 8 area), with uranium-radium being very significant in the latter area.

We now examine the various important minerals more closely.

**2. The basic industrial and transport minerals, coal, petroleum and iron ore.** Examine Figures 90 and 91 closely. It is necessary to look at both

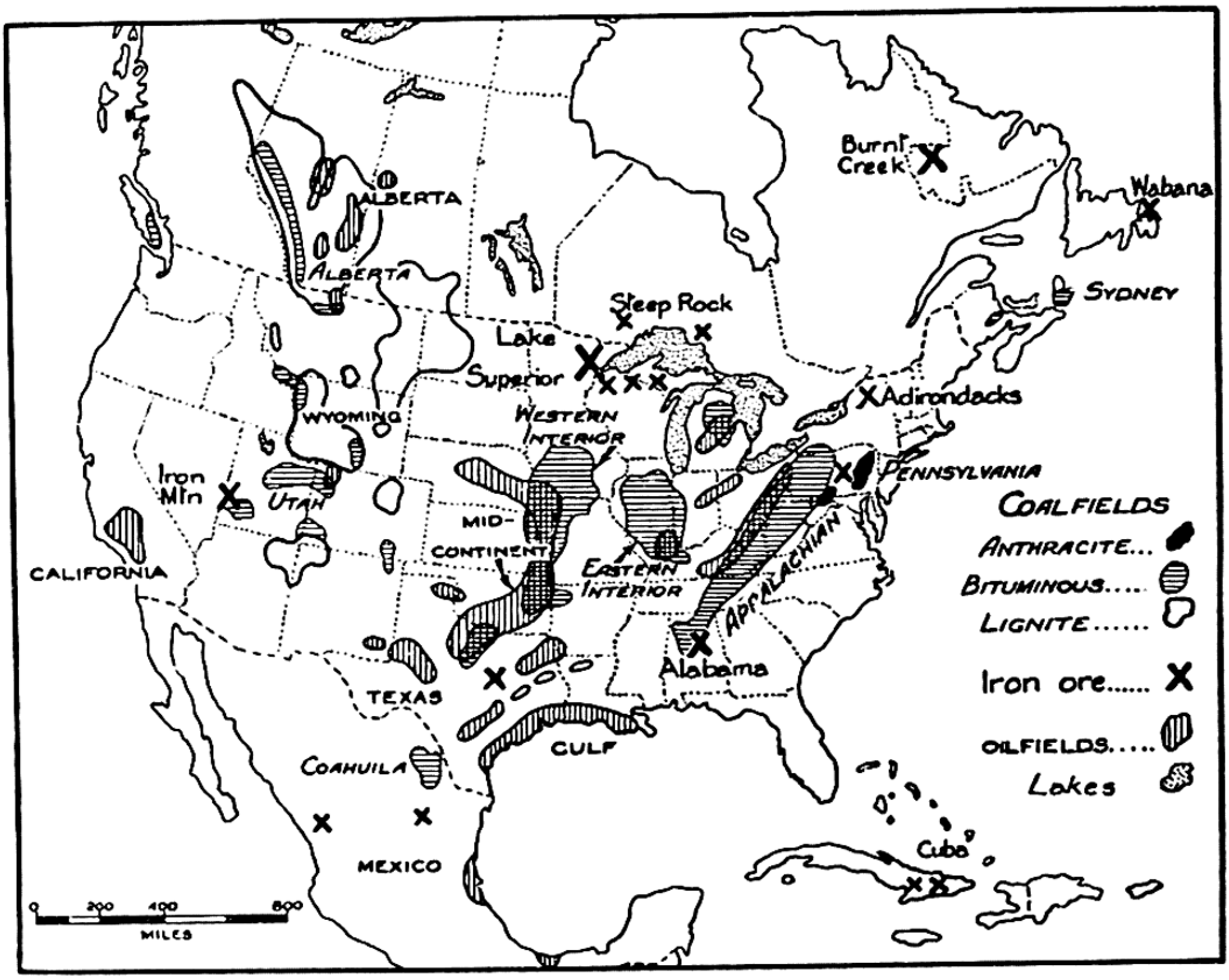


FIG. 90. *Distribution of coal, iron ore and petroleum in North America.*

figures to get an idea of the relative importance of the various areas shown on Figure 90. From these two figures it may be seen that the great coal-mining areas of North America lie in the Appalachians and the mid-west, while the petroleum areas are essentially in the south-west, with Texas as the hub and California as an important outlier. Iron ore is usefully scattered with the great concentration (and production) round Lake Superior.

(*a*) *Coal.* North America contains about half the world's known reserves of black coal and possibly two-thirds of the lignite. The black

(or bituminous) coal lies essentially in the east, where the Appalachian field has an output far greater than that of any other country in the world. In 1950-4 the annual production from the whole Appalachian field approximated 30 per cent of the world's total output. Furthermore, Pennsylvania has the world's greatest anthracite field, from which about 60 million tons are mined each year. The bituminous coal is used in transport, industry and coal-gas making; the anthracite is mainly a household coal but is also used in smelting non-ferrous metals. The great anthracite market is in the cities of north-eastern United States.

To the west, in Illinois, is a second large coalfield with a yearly output of 60 to 70 million tons. The coal is bituminous of various grades and is of great significance in industry and general heating in a cold region without trees. A third field of poorer coal in Missouri is also important for local use.

The remaining coalfields which lie in the Rockies are not very well developed, though in several instances, e.g., Alberta, Colorado, Utah and Wyoming, the coal mined, though of generally poor quality, has considerable local significance. The presence of abundant oil and natural gas fields throughout much of the western area has checked the development of coal mining. Oil is so much cleaner and easier to handle and both it and natural gas have a much higher heating value per unit of weight than poor quality coal.

In conclusion, notice how the quality of the coal generally deteriorates from east to west, from the anthracite of Pennsylvania to the lignite of Wyoming and Alberta, and finally to an almost complete absence of coal on the whole western coast and adjoining uplands. This distribution of coal has had a profound effect on manufacturing development (and on population distribution) throughout the whole continent. More will be learnt of this in a later chapter.

(*b*) *Petroleum.* With enormous and quite widely scattered oilfields, North America produces (1954) slightly less than half of the world's petroleum and over 90 per cent of the natural gas. It was the first country to make widespread use of petroleum products and the first to use modern drilling methods. The initial development took place in the Appalachian fields and later in those of the mid-west. Until the advent of the internal combustion engine (and its later development into the diesel and jet engine) petroleum and its products were of little significance in world affairs. Kerosene and some lubricating oils were the main products used, and the output was only a few million barrels yearly.

The extraordinarily rapid development of the motor-car on land, the diesel engine on the sea (and later on land) and the aeroplane engine (and later the jet engine), resulted in an ever-increasing demand for petroleum and its products. As new and larger oilfields were discovered on the shores of the Gulf of Mexico, in California, in Texas, Oklahoma and Kansas, and later in Wyoming and Alberta, the centre of gravity of oil production shifted rapidly westward. Today it is in the mid-continent

area in Texas, Louisiana and Oklahoma, with California as an important secondary area. The once significant Appalachian fields now produce very small amounts and the great Mexican fields of the early part of this century have declined to a minor place.

Despite an annual production of over 300 million tons of crude oil a year, the United States is a very large importer of petroleum and

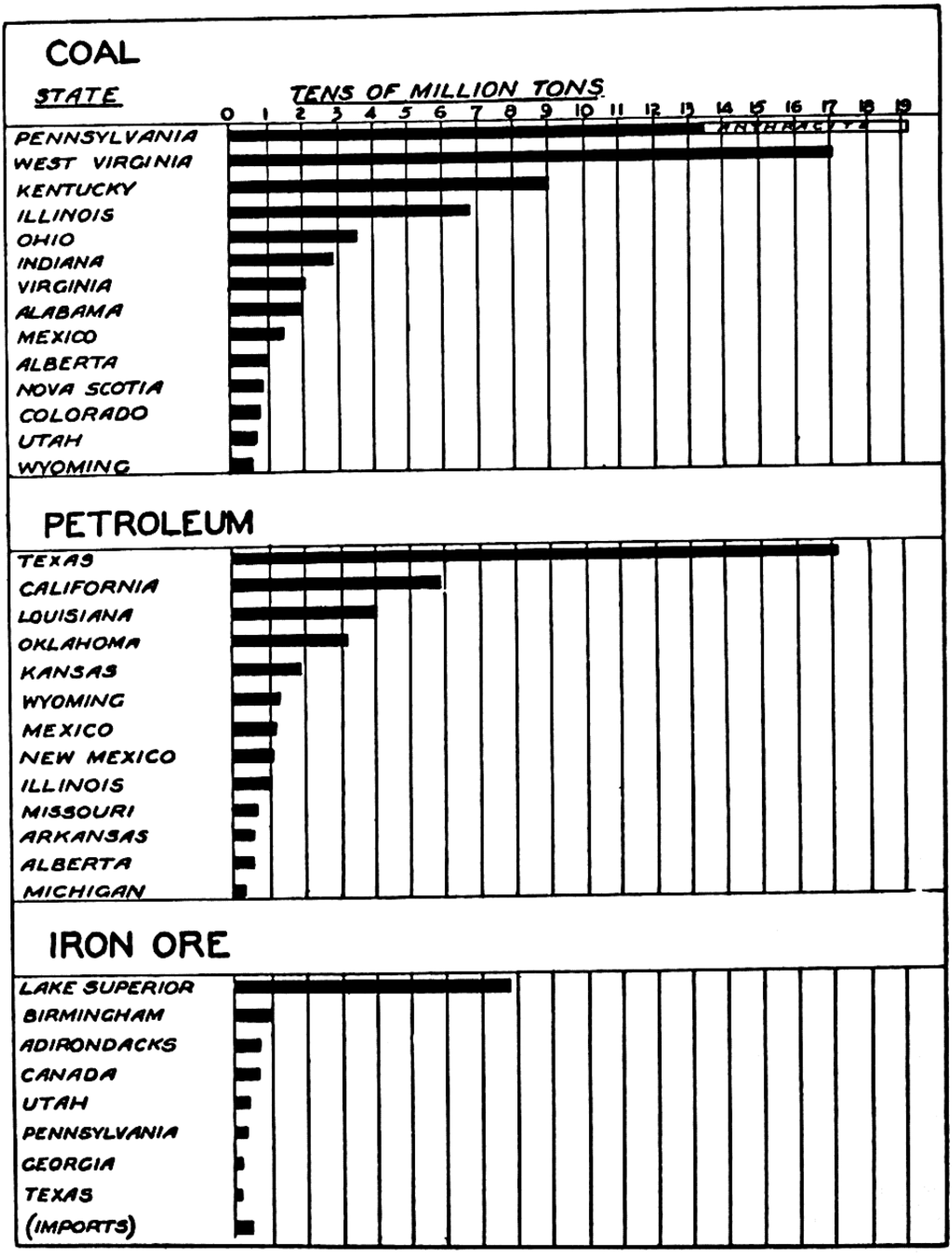


FIG. 91. *Graphs of the annual production of coal, iron ore and petroleum in North America (1952-4 average).*

its products from Venezuela and the Persian Gulf area. This is partly because local demand is outstripping local production, but also partly in an effort to eke out the steadily dwindling local oil supplies.

Since most of the oil is produced in the western half of the United States and Canada and most of the demand for petroleum products comes from the densely settled industrial areas of the east and the rich farm-lands of the mid-west, there is a large movement of oil (and oil products) across the continent from west to east. This movement is basically by pipeline, though freight trains and oil tankers move a fairly large proportion. Before the second World War revealed the appalling danger of tanker transport, at least half of the oil was moved by tanker from the Gulf ports of Tampico, Houston, Beaumont, New Orleans and Galveston to the clamorous markets of the north-east. Today much of that oil passes overland by the "Big Inch" (24-inch diameter) and the "Little Inch" (15-inch diameter) pipelines which start in Texas and Louisiana and finish in New York and New Jersey. In all, over 120,000 miles of pipelines collect the oil, carry it to refineries, and distribute the refined products to the market. Canada has just completed laying pipelines from the Alberta oilfields to both eastern and western populated areas.

In addition, a further 100,000 miles of pipeline take the natural gas from the western producing areas to towns and cities throughout the central and western farming areas. Here it is used for town lighting and heating in place of the coal gas used elsewhere.

(*c*) *Iron Ore.* North America, particularly the United States, has enormous reserve deposits of iron ore of varying grades. During the infancy of the great American steel industry, local ores adjacent to Pittsburgh were used in the newly established smelters. It was not until the last decade of the nineteenth century that the great iron ore bodies west and south of Lake Superior were fully opened up. These ores were 1000 miles from the smelting centres round Pittsburgh and a further 300 miles from the furnaces round Philadelphia and Baltimore. The difficulty of transport was largely overcome by using the Great Lakes. This necessitated building a series of canals round the rapids of Saulte Sainte Marie between Lakes Superior and Huron. These canals (the "Soo") now carry more traffic yearly than either Panama or Suez.

Much of the 70 to 90 million tons of ore obtained annually from the Lake Superior fields is quarried in the Mesabi ore bodies and sent by rail to Duluth, whence it is moved down the lakes by enormous ore-boats. The large-scale production, bulk handling and bulk movement tend to make for low freight charges.

So far there has been enough high-grade ore to meet demand, but there is every sign that the better-quality ores are becoming exhausted. There are still immense quantities of low-grade (30-40 per cent iron content) ore present, but it would need to be concentrated before being sent on its 1000-mile journey. Since this would greatly increase the cost, the larger companies have been searching far and wide for new large

ore bodies. The most promising find to date is at Burnt Creek in Labrador, where there are over 500 million tons of high-grade ore in sight on the surface. This ore body is now being actively developed, and a 360-mile railway has been built south to the port of Seven Islands on the St Lawrence estuary. From there the ore will be shipped up-river to the ports on Lake Erie. It is expected that production will reach a peak of 10-12 million tons a year by 1956.

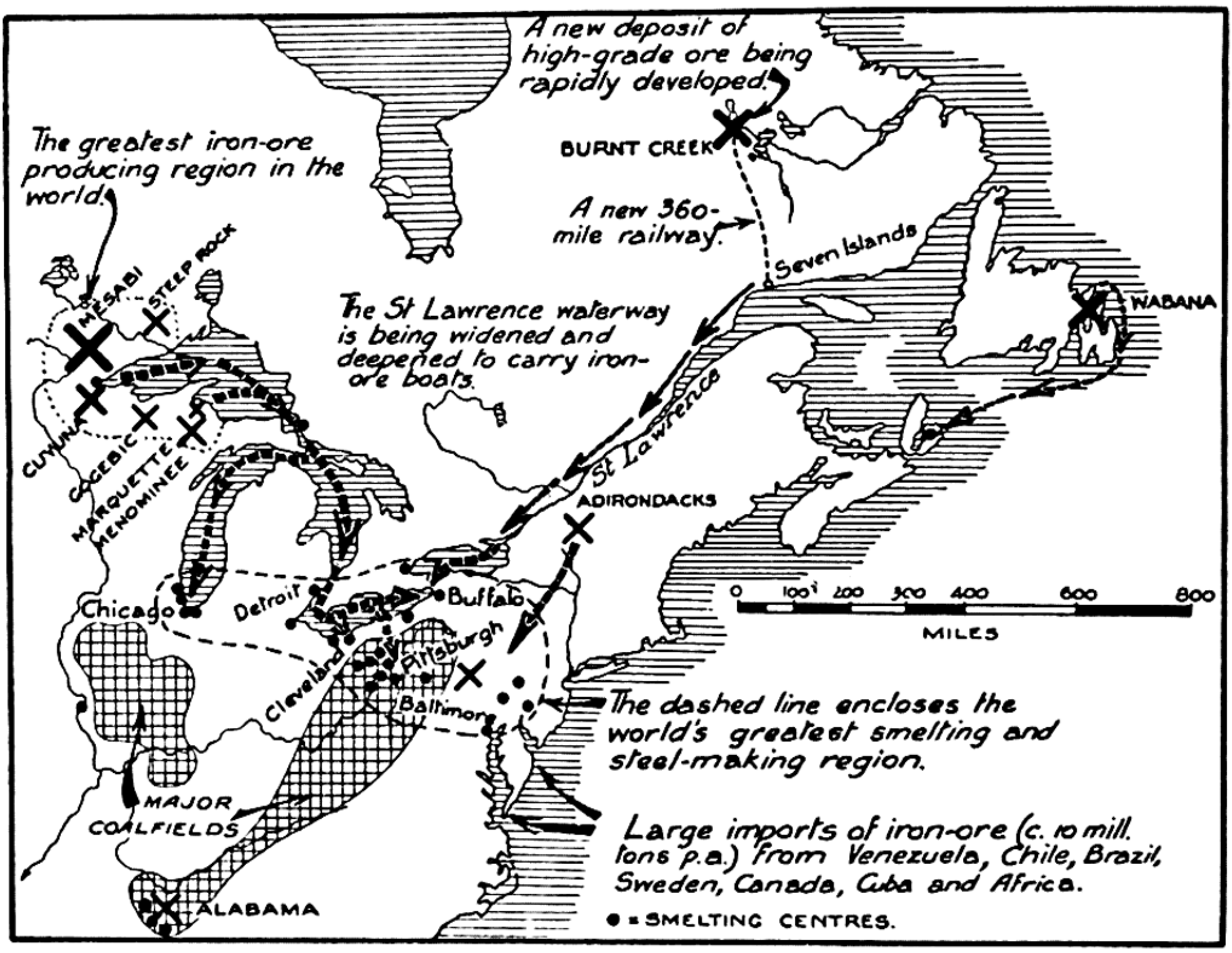


FIG. 92. *Map-summary of the basic features of the steel industry in North America.*

Figure 92 summarises the basic features of the great American steel industry. Its essential components are: (*a*) the enormous deposits of easily accessible, high-grade bituminous coal in the northern Appalachian coal-field; (*b*) the very large iron ore deposits round Lake Superior and Burnt Creek; (*c*) the navigable waterways of the Great Lakes and the St Lawrence.

In its early stages the industry was centred round Pittsburgh in the valleys of the Ohio, Monongahela and Mahoning rivers. Soon the expanding industry found the space in the narrow river valleys insufficient for its requirements, and new plants were set up in favourable positions along the shores of Lakes Erie and Michigan. Chicago and Gary at a later date were the centres on Lake Michigan, and the steel from them was used largely to meet demands from the rich farmlands of the corn

belt and the great wheat belts. On Lake Erie the lakeside centres of Toledo, Lorain, Cleveland, Erie and Buffalo, together with Detroit, were in the favourable position of being trans-shipping ports for the forward-moving ore. They could also get the necessary coal cheaply as back-loading on the trains taking ore to Pittsburgh and the nearby Valleys area. In addition, they lie on the main route from the east coast (at New York) to the interior and thus have transport to possible markets in two directions, inland and east to the coast. These favourable conditions, with the development of enormous industries dependent on steel, such as the automobile industry or the making of railway plant, have resulted in the growth of the Lakeside area, from Buffalo to Detroit, into one of the greatest steel-making regions in the world. Pittsburgh and its nearby centres alone outstrip it while Chicago-Gary is some distance behind in third place. Each of these sub-regions produces more steel than any other country in the world except possibly Russia. A further mention of this great steel-making area will be made in the chapter on manufactures.

Canada has much smaller supplies of coal and petroleum than the United States. The coal is mined principally at Sydney on Cape Breton Island, at Lethbridge in the Rockies, and in smaller amounts on Vancouver Island. It is all used locally. Normally it has to be supplemented by the import of some 10 million tons annually from the Appalachian fields.

Oil has recently assumed considerable importance in Alberta where some 8-10 million tons are now produced yearly. As mentioned above it is piped to Lake Superior and Vancouver and is now nearly sufficient to supply Canada's needs.

Iron ore has long been a major product of Newfoundland, where the rich Wabana ores are quarried and mined to be sent to Sydney for smelting or exported to Philadelphia and Baltimore (see Figure 92). A recent development has been the opening up of the rich ore body at Burnt Creek together with the developmental work on the enormous titanium-iron deposits at Allard Lake near the entrance to the St Lawrence estuary.

Mexico has limited supplies of bituminous coal in the north-east in Coahuila province and some fairly large iron ore deposits also in the north-east and north-west. These have been developed to supply a smelting works and steel plant at Monterrey. Production of steel here now approximates to one million tons yearly, and it is helping to build up an industrial superstructure on the Mexican economy.

Oil, once the outstanding mineral product of Mexico, is now of secondary importance. The great oilfields of Tampico and Vera Cruz have now settled down to a steady production of a little over 10 million tons of oil a year.

**3. Non-ferrous metals.** While the dominant industrial position of the United States in the world has largely been the result of the full exploitation of its great coal, oil and iron ore resources, it has been helped in no small measure by the great abundance and great variety of non-ferrous

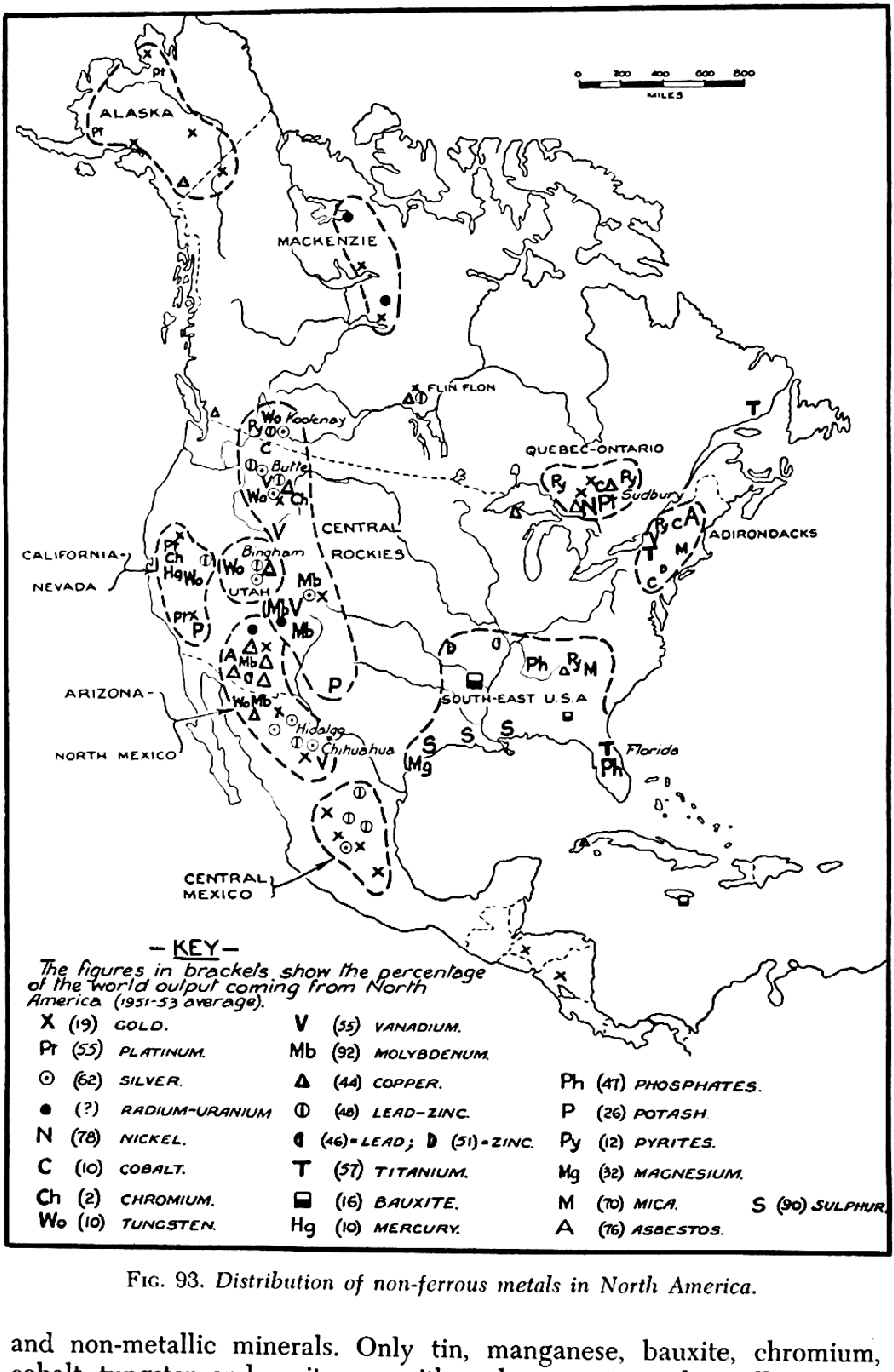


FIG. 93. *Distribution of non-ferrous metals in North America.*

and non-metallic minerals. Only tin, manganese, bauxite, chromium, cobalt, tungsten and pyrites are either absent or in such small amounts as to be insufficient for full industrial development. Figure 93 is most

illuminating in this regard. It shows the very widespread nature of the non-ferrous and non-fuel minerals, while the table appended to the map indicates how very important the North American continent is as a producer of these products. Neither the map nor the table mention building clays, stone (granites, sandstone, etc.) or limestone for smelting and cement making. Each of these is produced in enormous amounts.

Notice the tremendous importance of North America as a producer of the significant non-ferrous metals, copper, lead, zinc, nickel, titanium, magnesium, vanadium and molybdenum. Of these nickel, vanadium and molybdenum, together with tungsten and imported manganese and chromium, are essential in the making of steel. Aluminium is made in enormous quantities mainly from ore imported from British Guiana, Jamaica and Surinam, though the local Arkansas ore is also used. Of the other metals uranium-radium ores are produced in large amounts from the Mackenzie Basin and Utah, while the precious metals gold and silver are widespread throughout the Rocky Mountain system. The silver mines in Chihuahua (Mexico) have been the world's main producer for 400 years.

Non-metallic minerals of importance are sulphur from Louisiana and Texas; phosphates (for chemical fertilisers in a great farming land) from Florida and Tennessee; potash from California; mica from the Adirondacks and Carolina; and asbestos from the St Lawrence Valley (Thetford). All of these minerals have been used in an ever-increasing variety of ways in the expanding industrial world of the United States and Canada.

The procedure of ore-field smelting, mentioned under the general introduction above, is practised with all the non-ferrous metals obtained in North America. It is a common sight to find the smoke stack of a huge smelting plant tucked away in a Rocky Mountain valley or out in the deserts of Arizona and Mexico. The final refining of many of them requires electricity and is mostly carried on near the consuming centres.

## EXERCISES

1. What effect has the geographical distribution of coal, iron ore and steel alloy minerals had on the location of steel manufacturing throughout the world?

2. Discuss the location and production of mineral wealth, other than coal and iron, in North America.

3. Write a general account of the steel industry of eastern North America.

4. On a map of the United States mark in and name the chief coalfields. Describe the various uses to which the coal mined in each field is put.

5. Write a geographical account of the oil industry in the United States.

6. Compare the economic development of the minerals in eastern United States with that of eastern Brazil, and explain any differences noted.

7. Discuss the manner in which the development of the major mineral deposits in North America has affected the pattern of transport in the continent.

# CHAPTER XXIX

# MANUFACTURING IN NORTH AMERICA

## Factors Affecting the Development of Manufacturing

**1. The meaning of manufacturing.** The words "manufacturing" and "industry" tend to conjure up certain definite concepts in the minds of most people. Such things as factory buildings, machinery, large numbers of employees, crowded cities, important railway goods-yards, smoke, noise and bustle all seem to be connected with manufacturing industries. Most of the thoughts would be right for modern industrial centres; but it is very wrong to think that all manufacturing is done in factories or that all industry requires machinery.

Among the more primitive races it is customary for the tribal groups to make their own clothing, utensils and weapons. This is manufacturing in its simplest form, and it is quite common to find among the tribesmen certain members more skilled than others in the making of such articles. These tend to specialise at making goods for the whole tribe, who pay for such articles by supplying the artisan with food. Here we have a good example of a simple industry and an elementary factory.

Between this humble form of manufacturing and the industrial empire of a modern large steelworks or chemical works, a huge automobile or aeroplane manufacturing company is a very wide gap. But there are groups of people throughout the world with industrial undertakings at all stages between these two extremes.

Next step to the simple home industry so common among primitive peoples is that form where a group of people becomes noted for certain craft skills and combines in a village or town community to produce articles for sale. Such would be the weavers of Harris tweeds, the Navajo rug weavers and bead workers, the silver workers of many Indian villages, and the Chinese and Japanese silk weavers or ivory workers. Here we find groups of people combining to make the finished article. It is a product of many pairs of hands rather than of a single craftsman's. Modern industry uses this skill widely in many lands. Certain processes are let out to home workers, who bring the finished parts to a central factory for final assembly into a finished article. The Swiss clock makers, the Japanese toy makers and silk thread spinners, or the metal workers in many European village communities belong in this group. Here, at least part of the manufacturing is carried on in a traditional factory.

A third type of manufacturing industry is one like brick-making or glass-blowing, where human skill and human knowledge are still widely (though decreasingly) used in making various products.

Finally, the modern factory is not always a colossus like a steelworks or a huge oil refinery or a chemical works. Many industries, especially the making of articles of clothing, ornaments and jewellery, are carried out in quite small factories with small groups of skilled employees, even in the most advanced countries.

It would therefore seem that some form of manufacturing is to be found among all peoples on this earth, the level of industrial development depending largely on the technological level of the people concerned. Higher technological development tends to make a fuller use of available raw materials and to set up more efficient and more complicated industrial processes to do this. As with farming, the development of manufacturing depends largely on the educational level of a people.

In our description of manufacturing we deal exclusively with industrial activities among peoples at a high level of technological development.

**2. The industrial revolution**. Great industrial countries did not appear overnight. The enormous present-day manufacturing industries in Britain, the United States, Germany, France, Japan, Belgium or even Australia have developed as a result of an evolutionary rather than a revolutionary process.

Two hundred years ago all manufacturing was one of simple processes carried on in the household or in a shop (or guild). At that time most manufacturing was done by hand aided by simple tools; the word "manufacturing" means "making by hand", and that was then literally true. During the eighteenth century—and more especially during its latter half—a revolution was brought about in the manufacturing of textiles in England. At first applied to the spinning of thread, machines were later developed to weave the thread into cloth at a greatly increased rate. The primitive early spinning and weaving machines were rapidly improved and enlarged until they could no longer be housed in the home or a small shed nearby. About the same time James Watt succeeded in producing a steam engine that could be used in place of water power to drive the new machinery. With the advent of steam power to drive the new and enlarged machines, the Industrial Revolution was achieved and the modern Industrial Age was born.

When all this happened, far-reaching changes took place in manufacturing and the lives of the men and women who were engaged in it. Manufacturing moved from the homes and the small shops to the factories. It was more practical to house many machines in one building or group of adjacent buildings; the factory city now made its appearance in place of the country town. Because of the need for coal for heating to give steam power, and of flat land for building the factories and roads that carried the materials to and from them, these factory towns grew up in the first place on coalfields either on flat plains or in valleys in hilly land.

The changes introduced into the textile industry in England also

happened at a later date in France, Germany, the United States, and since 1930, the U.S.S.R. These five countries were destined to become the great industrial nations of the modern world. At the same time the manufacturing changes spread to other industries. Carriage making by the local carriage maker developed into the great automobile plants of today. Printing on the small hand press grew into the huge printing establishments with their giant presses; the grist mill with its windsails or waterwheels became the huge modern flour-mill; and the little iron forge gradually grew into the mammoth steel plant as newer and more efficient methods of smelting ores and making steel were evolved.

All this did not happen at once; it has been going on for over 150 years. Do not make the mistake of thinking that this Industrial Revolution is over and done with. The beginning was in those days when the inventors began to stir England; the end is not yet in sight, for man is still finding newer and more efficient ways of manufacturing goods.

3. **Mass production.** During the twentieth century several further changes have occurred in industry. In the United States, for example, only about one per cent of the factories employ more than 500 workers apiece; yet they employ a total of more than 40 per cent of the factory workers to produce nearly 50 per cent of all manufactured goods. This is the age of mass production by large-scale industrial undertakings.

Mass production has made possible the creation of a far greater volume and variety of manufactured goods than the world has ever known before. Millions of automobiles, refrigerators, washing machines, household utensils, shoes, suits of clothing or shirts and blouses can now be produced more easily and more cheaply than was ever possible during the nineteenth century. One of the chief reasons for the ability to produce an article more cheaply has been the fact that the factory system (and mass production) has brought with it a division of labour. Under this system the labour in making any article is spread among many workers and the output per worker (aided by ever-increasing amounts of machinery) has increased greatly.

Large-scale industry usually makes large profits. A proportion of these is normally devoted to experiment and research and then to buying new machines to use in introducing better manufacturing methods evolved by the research work.

Large industries also are able to make a fuller use of by-products and thereby to cut wastage. This is well illustrated in the case of the meat-packing industry. In its early days there were many parts of the animal that could not be used by industry. Today, as has often been remarked, the meat-packing industry has found a use for every part of a pig but the squeal, and for every part of a cow but the bellow.

By setting up control (usually by gradual purchase) over the sources of raw materials, companies may obtain their factory requirements more cheaply. This process, known as *vertical integration*, is quite common in

industry today. A large steelworks will own the coal mines, ore mines, transport factors (ships and trains) as well as the steel plant; and automobile companies own the plants that produce glass for their windshields, upholstering material for the seats or spark plugs for the engines and so on.

**4. Factors affecting the establishment of industries.** Many reasons may be found for the setting up of industries and the growth of industrial cities in certain locations. These will vary somewhat with different industries and among different peoples, but among them will be found a common group. This is a sort of highest common factor of all the reasons observed.

Figure 94 summarises the average condition of the factors affecting the development of manufacturing. The pattern shown consists of five main stages:

(*a*) obtaining the raw materials;
(*b*) transporting the raw materials to the factory;
(*c*) processing in the factory to produce manufactured goods;
(*d*) transport of the processed goods from the factory;
(*e*) consumption of manufactured goods in the markets.

Certain facts emerge as being very important in this pattern. The first is the need for transport. All factories depend on transport for their continued existence and are accordingly set up at places close to main lines of transport, which may be sea, rail or road, depending on the type of factory and the goods it is making. Secondly, the factories and the industrial cities that develop round them must be regarded as being fixed in their position. Once the industrial pattern is set up it is a very difficult matter to move it to a new site. The factory buildings, with their machinery and the large residential suburbs surrounding the factories, have a general air of permanency. This is strengthened by the building of railways and spur lines from them to the factory sites as well as by laying down roads capable of carrying large amounts of heavy transport. These transport routes (which may include canals and docks if the factory city is on the coast) may be looked on as tying the industrial city to its chosen site.

In a few instances factories have been built on sites that were unfavourable and have had to be removed or closed down because they could not compete economically with better-situated industries. The poor situation has generally been chosen by an individual (or board of directors) for personal reasons, but these may not be sound geographical reasons. The Lithgow steelworks set up by Hoskins Ltd in New South Wales is a very good example of such a plant. Despite Government assistance it was only able to struggle on for a quarter of a century before economic-geographical considerations forced its removal to a more suitable site at Port Kembla.

In Figure 94 some of the major factors favourable to setting up factories and industrial cities have been listed in the central block. These are

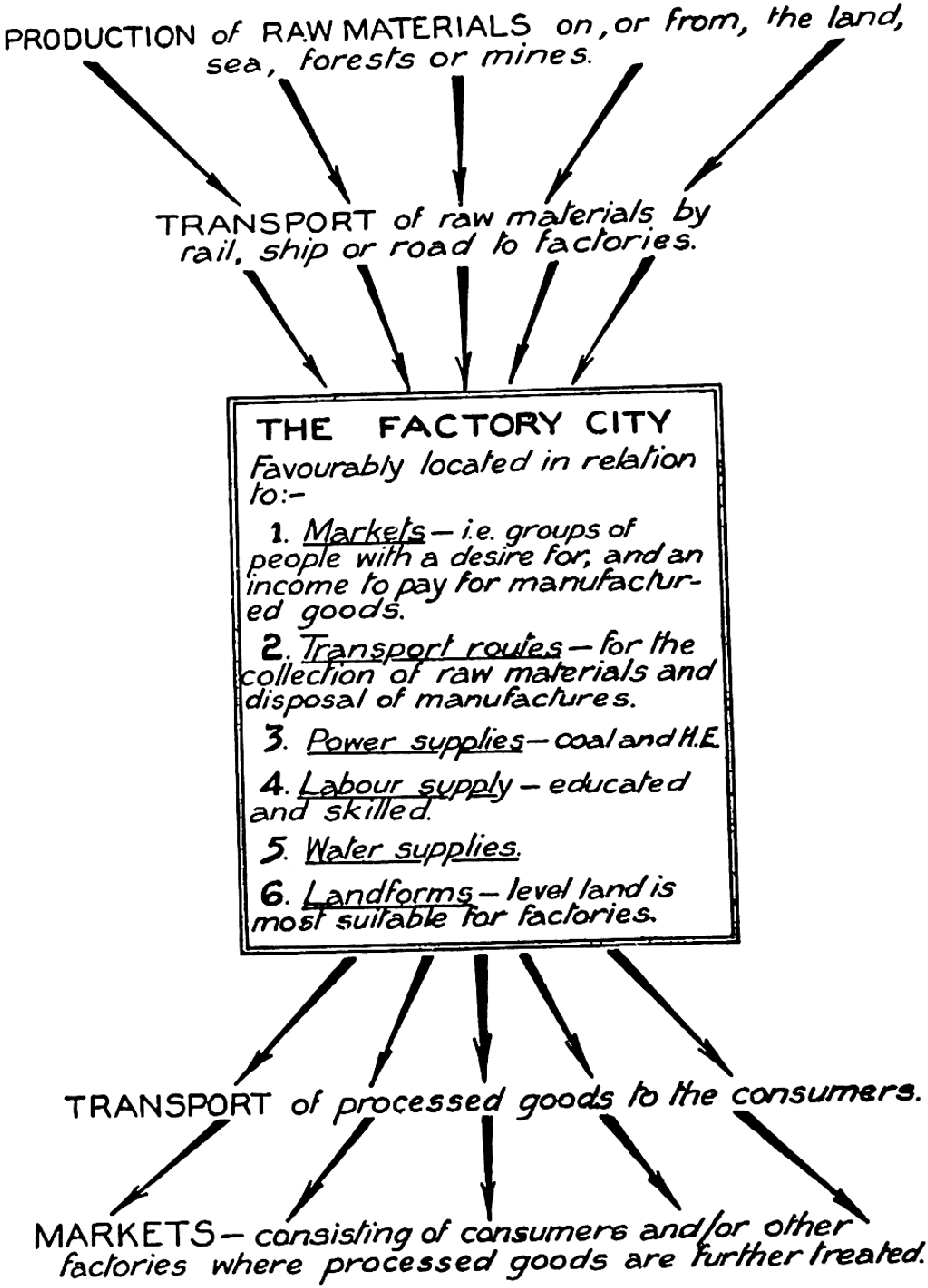


FIG. 94. *Generalised diagram of the factors affecting the development of manufacturing industries and industrial towns.*

not arranged in order of importance, though markets are undoubtedly more significant than water supplies or labour supply. Both of the latter can be brought to the factory town, either by pipeline or by attractive wages and housing conditions respectively. Notice that under the heading "Markets" is implied a community at a high technological level, that is, people who desire and see the need for manufactured goods to help them in their daily lives. It is very doubtful whether any primitive peoples could use manufactured goods effectively unless they were first educated to the need for them.

In addition to the factors listed, there are several others that can be significant with some industries:

(*a*) If several sites have been examined and found favourable, the personal choice of the company directors decides just where the industry shall be set up. This point is well illustrated with the siting of the Gary steel plant or the new Fairchild plant near Philadelphia. In each case the actual site chosen was one of several that were suitable and available.

(*b*) Government interference can be important in many ways. The offering of land at a low rating value or the granting of freight concessions on goods carried on Government transport systems can tip the scale in favour of a certain place. This is shown in the setting up of the General Motors-Holden factory in South Australia or the Courtaulds rayon textile mills at Hexham in New South Wales. There are many other instances of the importance of Government concessions and quite often the actual site chosen is the result of bargaining between the factory owners and various State or municipal Governments.

(*c*) For the general development of manufacturing in a country, there must be abundant capital to set up the industries. Regions or nations with abundant capital are in a position to become industrially important, those lacking in surplus capital are not. From all of these factors it may be said that the basic ones for the development of manufacturing regions are:

(*a*) sufficient technical knowledge;
(*b*) abundant supplies of coal, or hydro-electric power, and iron ore;
(*c*) access to transport routes;
(*d*) sufficient capital.

No major industrial regions exist where a combination of these factors is not present.

## MANUFACTURING REGIONS IN NORTH AMERICA

### Canada

A great expansion has taken place in Canadian manufactures since the second World War. During the war there was a big development of aluminium refining, steel making and in the making of chemicals and machine tools. This laid the foundation for developments after the war.

Huge new industries have been built to manufacture magnesium, synthetic rubber, optical glass, penicillin and sulpha drugs. In addition there has been a continued expansion in the paper-making, automobile and electrical industries, plus a rapid development of oil refineries to process the ever-increasing output of Alberta oil.

About half of the Canadian industrial output is accounted for by fifteen leading industries based on the utilisation of forests, food resources, iron and steel, fuel and power. These industries are lumbering and paper making, slaughtering and meat packing, smelting and refining of non-ferrous metals, motor car manufacturing, petroleum refining, food manufactures (butter, cheese, flour), iron and steel making, railway rolling stock, cloth and clothing and rubber goods.

The industrial areas are located primarily along the St Lawrence Valley; the northern shores of Lake Ontario and in the Lakes Peninsula, with important secondary areas in British Columbia and in various cities on the prairies. The principal manufacturing centres are: Montreal, Toronto, Hamilton, Windsor, Oshawa, Sarnia, Kitchener, London, Brentford, Quebec, Saulte Ste Marie, Willand, Three Rivers, Ottawa and Shawinigan Falls in the eastern area and Vancouver, Winnipeg, Calgary, Edmonton and St Boniface in the west and on the prairies.

The most recent addition to the industrial plants of Canada is the new power station and aluminium smelting plant at Kitimat on the head of a fiord near Prince Rupert (British Columbia). The whole scheme necessitated the damming and diversion of an inland river through a 10-mile tunnel to a huge power station inside the mountain. Then the power is conveyed by a 48-mile transmission line to the refinery. This is very similar in plan to the Snowy Mountains Scheme in south-east Australia but is much smaller in size.

### United States

Owing mainly to the fortuitous combination of immense resources of the essential raw materials of coal and iron ore and the advent of enterprising European settlers with capital to invest in industry, the north-east region of the United States has become the world's greatest manufacturing area. Though production from the sub-regions marked 1 to 10 on Figure 95 far exceeds that of the rest of the continent, there have been significant manufacturing developments elsewhere in the United States since the first World War.

First among these is the *Piedmont belt* of the south-east (Numbers 11-13 on Figure 95). Originally the manufacturing here was confined to small centres along the Fall Line, where water-power was available to turn the machines. The development of a large iron and steel industry in the Warrior Valley round Birmingham (Alabama) was the first major step in the growth of secondary industries in the south-east. This was followed by the establishment of many textile factories to manufacture

cotton materials from the local raw cotton and then clothing from the cotton materials. Later, the development of cigarette and tobacco factories, furniture factories, paper mills, rayon and cellulose factories and chemical fertiliser factories has given the Piedmont belt considerable diversification of industry and a large industrial superstructure.

The coming of the Tennessee Valley Authority (T.V.A.) during the late 1930s brought an abundance of electric power to the Tennessee Valley and across the highlands to much of the Piedmont. As well as easing the problem of power for Piedmont factories it also allowed for the development of nuclear fission plants at Oak Ridge and aluminium refineries at Badin (N.C.).

Secondly, the building of huge reservoirs like Grand Coulee, Bonneville Dam, Hoover (Boulder) Dam and Shasta Dam, each with enormous power plants, has made available an abundance of electrical energy to the coal-starved *Pacific Coast States*. This has resulted in a swift growth of industry throughout the States of California, Oregon and Washington. Much of the newer industry is concerned with the processing of products from the forests, the farms and the sea. There are many saw mills and joinery works, paper mills, wood-board (masonite), and plywood mills, and fish canneries in Washington and Oregon, while California has large canning works to process the products of its orchards and market gardens. Newer industries, largely using electrical power, include copper smelting and refining at Tacoma (with the largest copper smelter and refinery in America); aluminium smelting at Vancouver (in the State of Washington), Tacoma, and Troutdale; aeroplane manufacture at Seattle (Boeing), San Diego and Los Angeles (which is the largest aeroplane manufacturing city in the world).

There is also a new fully integrated steelworks at Fontana, 50 miles inland from Los Angeles. Though small by comparison with some eastern steelworks, this plant supplies much of the steel required by the Pacific Coast and is therefore of local significance. It gets its fuel from Utah, 800 miles away, its ore partly from California and partly from Utah, its limestone from a local quarry, and its scrap from California. It has to buy its water but saves on costs by cooling and re-using it.

Oil refining is important round Los Angeles and in California, and Los Angeles is also a major centre for the manufacture of sports clothes; this city is a style centre for clothes (and furniture) mainly through the impact of Hollywood on the rest of America. In addition, Los Angeles is still the world centre of the motion picture industry.

Thirdly, there has been considerable development of secondary industries in the south-west, where Texas now has an important industrial structure based on oil refining, chemical industries, food processing and metallurgical industries (tin, aluminium, steel, zinc and magnesium).

Fourthly, there are, outside the north-east manufacturing belt, many isolated manufacturing centres throughout the corn belt and wheat lands. These are concerned primarily with the processing of local farm products,

so that flour mills, meat-works and mills for treating soy beans or corn are important in them. Also in the Rockie are isolated important metal treatment centres among which Butte (Montana), Denver (Colorado) and Provo Steelworks (Utah) are examples.

### The North-east Industrial Area

This huge area is about 1000 miles from east to west and from 200 to 400 miles wide from north to south. This means that it is about equal in area to the whole State of New South Wales or to the more densely settled area of south-east Australia extending from Brisbane to Adelaide. It is mapped on Figure 95 and constant reference to this figure is necessary. Throughout this vast area the dominant activity is manufacturing and the main way of life is that of the city. Nevertheless farming is also very important once the actual boundaries of the cities are left behind. The agricultural industry here produces very large quantities of meat, fruits, dairy produce, vegetables and root crops for the huge city populations. In fact the development of industry and city populations has been made possible partly by the ability of the nearby farmlands to provide a large proportion of the ever-increasing demand for perishable foodstuffs.

As would be expected over such a large area, there is considerable diversification of industry together with a tendency for manufacturing to develop at nodal points where the general conditions noted in Figure 94 are more favourable. This makes it possible to divide the area into a pattern of sub-regions for purposes of description. One such broad pattern is shown in Figure 95 and it will be used throughout the remainder of discussion.

**Number 1 Region. The New England area** saw the beginnings of American manufacturing. Its early industry was based on textiles, boots and shoes; a supply of skilled immigrant labour from Europe; and abundant water power from running streams. Among the early advantages for the making of cotton textiles were: (1) location near a major marketing area; (2) excellent water power facilities; (3) clean, soft water for bleaching and dyeing; (4) damp air for spinning (now provided by humidifiers in the factories); and (5) skilled local labour. Since 1920 the New England area has yielded supremacy in cotton goods to the Piedmont, where cheaper labour, more up-to-date mills, nearness to raw material supplies and a large local market have been the advantages. New England now concentrates on finer materials.

The area is still the principal woollen manufacturing region in America, using both local wool (from the Rockies) and imported wools, which come in mainly through Boston. Both the woollen and cotton textile industries are situated in Massachusetts and Rhode Island States with Boston and Providence as the focal points.

Boots and shoes have long been a major New England industry, and the area still leads in United States production. Its position is threatened

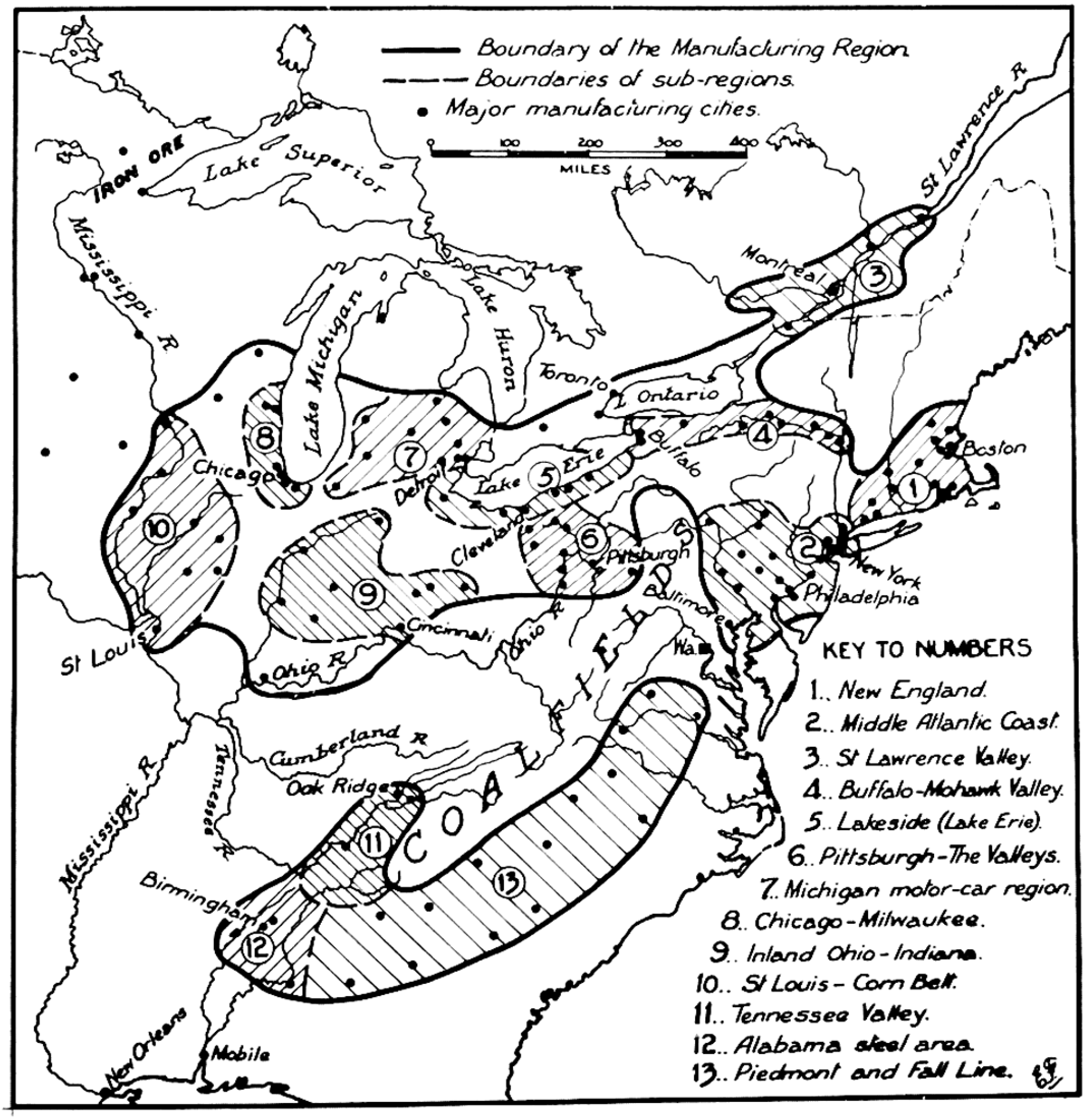


FIG. 95. *Sub-regions of the major manufacturing regions of North America.*

by other centres in the middle-west with large local markets and better access to raw materials.

The manufacture of a wide variety of small metal goods is now a significant feature of New England industry. Tools, hardware, firearms, electrical supplies, typewriters, clocks and watches, optical goods, brassware, precision instruments and plastics are all made in large quantities throughout the area. Lacking the basic steel industry because of an absence of coal and iron ore, the region has tended to import processed metal and make it into articles which are small in bulk and high in price (cf. Switzerland).

**Number 2 Region. The middle Atlantic coast** includes New York, New Jersey and eastern Pennsylvania and Maryland. The basic industries are

concerned with coal mining, steel making and chemical manufactures; but the seaboard location and the enormous local market (there are at least 25 million people living in the Number 2 region) have led to the growth of a host of other industries.

Though New York is primarily a seaport, handling about 40 per cent of American trade, it also has a very large industrial output. Besides the usual food processing, clothing, furniture and household utensil industries found in any large urban region, the New York region has certain distinctive industries. Among these may be noted:

(*a*) The garment industry, which has 7000 small factories mainly grouped in lower central Manhattan and producing enormous quantities of ready-made clothing for men and women, and furs for women.

(*b*) Oil-refining is concentrated in the south-western part of the urban area at Bayonne. This is the world's greatest oil-refining centre.

(*c*) A huge chemical industry produces acids, ammonia, soda, potash and pharmaceuticals.

(*d*) The printing of magazines and books is a major industry in the island of Manhattan.

(*e*) Meat packing on the Jersey shore has long been important. The animals are brought by rail from the mid-west and are canned both for local use and exporting. Associated meat slaughtering is also of great significance. This has developed largely because the Jewish population of New York demands Kosher meats in large quantities.

South-eastern Pennsylvania and Maryland, comprising the area from Philadelphia to Baltimore and inland to Scranton and Harrisburg, is concerned with smelting iron ore and steel making. The basic raw materials come from widely separated localities—the coal from the Appalachian fields and the iron ore from overseas (see Figure 92)—but the seaboard location close to the huge local markets has enabled a prosperous smelting industry to develop. The huge new Fairless plant built at a cost of $450 million at Morrisville and the large Sparrow's Point steelworks are examples of the faith of the steel companies in the future of this region.

Besides steel there are many industries depending on it. Shipbuilding, railway rolling stock, machine tools and machinery of all kinds are examples. Aircraft manufacture is particularly important near Baltimore, Paterson, Philadelphia and West Trenton. Petroleum refining is again a big industry; and chemical manufactures (e.g., by the Du Pont plant), sugar refining (of Cuban raw sugar), linoleum and carpet making are all important industries throughout this part of the Atlantic Coast sub-region.

**Number 3 Region. The St Lawrence Valley** is a smaller region, as regards output, than Numbers 1 and 2. Its main industries are concerned with the manufacture of aluminium, lumber, paper and paper-pulp, flour, textiles, sugar, chemicals, railway equipment, electrical goods, agricultural

machinery, shoes, cement and aircraft—just the varied list one would expect in an expanding economy of a young country like Canada. Among these the manufacture of paper and paper-pulp is of great importance and the area round Three Rivers is the world's leading paper and pulp centre. Over 80 per cent of the paper is exported to the United States, mainly as newsprint.

The world's largest aluminium plant is situated at Arvida on the Saguenay River. It uses hydro-electric power from that river and bauxite from Jamaica and British Guiana.

**Number 4 Region. The Buffalo-Mohawk Valley area** occupies the great water-level route from Troy to Buffalo through which pass the roads, railways and a canal linking the mid-west to New York. The advantageous position on a route carrying large amounts of raw materials and with a market at both ends has led to considerable manufacturing development.

At Buffalo are the huge Lackawanna steelworks and enormous flour mills, the one treating Superior ores with Appalachian coal, the other making flour from Canadian and mid-west wheat in sufficient quantities to make Buffalo the world's leading flour-milling centre.

The proximity of power from Niagara Falls has led to industrial development along the Mohawk Valley, where Rochester specialises in cameras, optical goods and men's clothing; Syracuse in typewriters and shoes; Rome in copper and brass; Schenectady in electrical equipment (A.G.E. Coy) and locomotives; Troy in men's shirts (Arrow brand) and Gloversville in gloves.

**Number 5 Region. The Lakeside area** lies along the southern shores of Lake Erie. Here are a number of lake ports, which handle iron ore and limestone moving to the Pittsburgh area, and which have developed industries of their own based mainly on smelting and steel making. Their favourable position in relation to raw material supplies was noted earlier and they also lie on the main highway from the mid-west to the coast. Cleveland is the principal centre, followed by Toledo, Erie and Lorain. In all of these, steel plants produce the raw materials for fabricating mills making railway rolling stock, household electrical equipment (refrigerators, washing machines, etc.), tinplate, motor car bodies and parts, containers of all kinds and general structural steel.

**Number 6 Region. Pittsburgh and the Valleys** includes the centres of Youngstown, Canton, Steubenville and Wheeling as well as Pittsburgh. Steel making is the major industry here and this area is one of the most favourably situated in the American continent in regard to supplies of raw materials and markets.

Besides the enormous steel industry the area contains the world's greatest rubber manufacturing centre at Akron (its location was largely the result of personal choice of his home town by B. F. Goodrich in 1840). Other great industries are concerned with: glass making; clay products

(firebricks, tiles, chinaware and vitrified sewer pipes); machine tools; electrical equipment; railway rolling stock; chemicals; motor vehicles; paints; clothing and aeroplane parts.

**Number 7 Region. The Michigan motor car region.** Starting in Detroit at the beginning of this century the motor car industry has now spilled out into many nearby—and some distant—centres. Detroit is still the hub and focal point; but Pontiac, Flint, Monroe, Ann Arbor, Ypsilanti, Lansing, South Bend, Owosso, Port Huron and Toledo are all significant automobile centres today. The motor car is an assembled product and requires many supporting industrial plants to make the hundreds of parts that go into the construction. These plants are scattered far and wide throughout eastern America and the south Michigan region is known as the motor car centre of the world, mainly because it has the largest number of great assembly plants within its boundaries. Detroit became the main centre mainly by its accidental position at the hub of a region wherein lived and worked the great pioneers of the industry. The whole industry here is dominated by three large corporations which together supply over three-quarters of the world's motor vehicles. The largest of the three is the General Motors Corporation and this is followed by the Ford Motor Company and the Chrysler Corporation.

Besides the assembling of cars and trucks and the manufacture of their many parts, the lower Michigan region also makes furniture, agricultural implements and chemicals.

**Number 8 Region. The Chicago-Milwaukee area** is situated on the south-western corner of Lake Michigan and extends from Gary to Milwaukee. Heavy industries predominate here, and Gary and Chicago are the best-situated and best-balanced primary metallurgical districts in America. They are far better related to transport routes and markets than Pittsburgh and are equally as favourably situated regarding iron ore and coal. The basic manufacturing activity here is the great iron and steel industry of Gary, Indiana Harbour and south Chicago. From this pours the millions of tons of steel used by a host of subsidiary industries throughout this region and southwards into Number 9 and Number 10 regions. Agricultural machinery, electrical goods, oil refining plant, motor cars, tractors, hardware and containers are all produced here in vast quantities.

Besides the products of steel, Chicago is the greatest slaughtering and meat-packing centre in the world. Over 15 million animals a year pass through its slaughterhouses; but it is steadily declining in importance as the industry moves to more favourable localities throughout the corn belt and the south-west.

Petroleum refining is also an important Chicago industry. The oil is brought by pipeline, mainly from Kansas, Texas and Oklahoma, and the finished products are used throughout the city and adjacent highly mechanised farmlands.

**Number 9 Region. Inland Ohio and Indiana.** This district lacking in coal and iron ore is nevertheless strategically located in relation to Pittsburgh, the Lakeside area and the Chicago-Milwaukee region. Its industries are very diversified and include the manufacture of machine tools, cash registers, calculating machines, petrol pumps, electric refrigerators, aircraft, soaps, tobacco, meats, radios, clothing, beer and shoes. Agriculture is still very important throughout the whole of this region: many industries are concerned with supplying the farmers with implements and machinery; others treat the products of the farms. This explains the importance of flour milling, meat packing and vegetable canning in the western part of the region.

**Number 10 Region. The St Louis-Corn Belt area.** St Louis, because of its nodal position, is a great general manufacturing centre with steel making, agricultural implements, tractors and cars, petroleum refining, chemicals, electrical equipment, corn processing plants, meat packing as its main industries. The other centres indicated in Region 10 on Figure 95 are concerned mainly with meat packing and the manufacture of farming equipment for the agricultural corn and wheat belts surrounding them.

## EXERCISES

1. On a map of North America mark in and name the main coal, iron ore and petroleum producing regions. What effect has the distribution of the above had on the localisation and development of large scale manufacturing industries?

2. What are the major factors favourable for the development of industrial regions? Show how these factors have helped to create *one* of the following regions:—
   (a) New England region of the United States.
   (b) Southern California.
   (c) Piedmont belt of the United States.
   (d) Lake Erie region.

3. Compare and contrast the manufacturing industries of the Pacific Coast of America from Los Angeles to Vancouver with those of the Atlantic coast between New York and New Norfolk. Account for any differences you may note.

4. Compare and contrast the physical characteristics (climate, landforms and soils) and the agricultural and industrial development of California and *either* the St Lawrence Valley *or* New England, U.S.A.

5. What important industrial areas in the U.S.A. and Canada have developed *without* local coal resources. Describe one such area in some detail and explain its growth.

6. Discuss the significance (economic and geographic) of the recently opened mineral areas in Alberta and Labrador.

7. Locate the major areas of iron-smelting and steel-making in the United States. Consider in some detail the advantages of any *one* of them for the carrying out of this industry.

8. Examine the advantages of Ontario and Quebec for the development of manufacturing industries.

9. Give a reasoned account of the main contrasts of land utilisation between Texas and the Prairie Provinces of Canada.

# CHAPTER XXX

# POPULATION, NORTH AMERICA

**1. Distribution and density.** The following table shows the general distribution of population and the approximate density of countries in North America:

| *Country* | *Population 1955 (Approximate)* | *Density (per sq. mile)* |
|---|---|---|
| Alaska | 150,000 | 0.25 |
| Canada | 16,000,000 | 5 |
| Costa Rica | 1,000,000 | 50 |
| Cuba | 6,000,000 | 132 |
| El Salvador | 2,200,000 | 270 |
| Guatemala | 3,000,000 | 75 |
| Haiti | 3,500,000 | 320 |
| Honduras | 1,600,000 | 35 |
| Jamaica | 1,300,000 | 310 |
| Mexico | 28,000,000 | 38 |
| Nicaragua | 1,200,000 | 21 |
| Panama | 1,000,000 | 32 |
| Puerto Rico | 2,500,000 | 650 |
| Santo Domingo | 2,500,000 | 135 |
| United States | 166,000,000 | 55 |
| North America | 235,950,000 | 26 |

A brief examination of these figures reveals several interesting features:

(*a*) the dominant position of the United States, with nearly three-quarters of North American population;

(*b*) the great variation in population densities, with the highest figures in tropical lands;

(*c*) the general low densities of the colder lands of Canada and Alaska;

(*d*) the average density of the whole continent, being well below the average of 46 for the world, partly because nearly half of North America is practically uninhabited.

Useful as the table is for rough general comparisons, it tends to mask some very vital features of distribution and density. These can be seen more clearly by studying Figures 96 and 97. Figure 96 shows clearly that most of Canada, all of Alaska and quite large areas in the United States, Mexico and Central America have a very low density of popula-

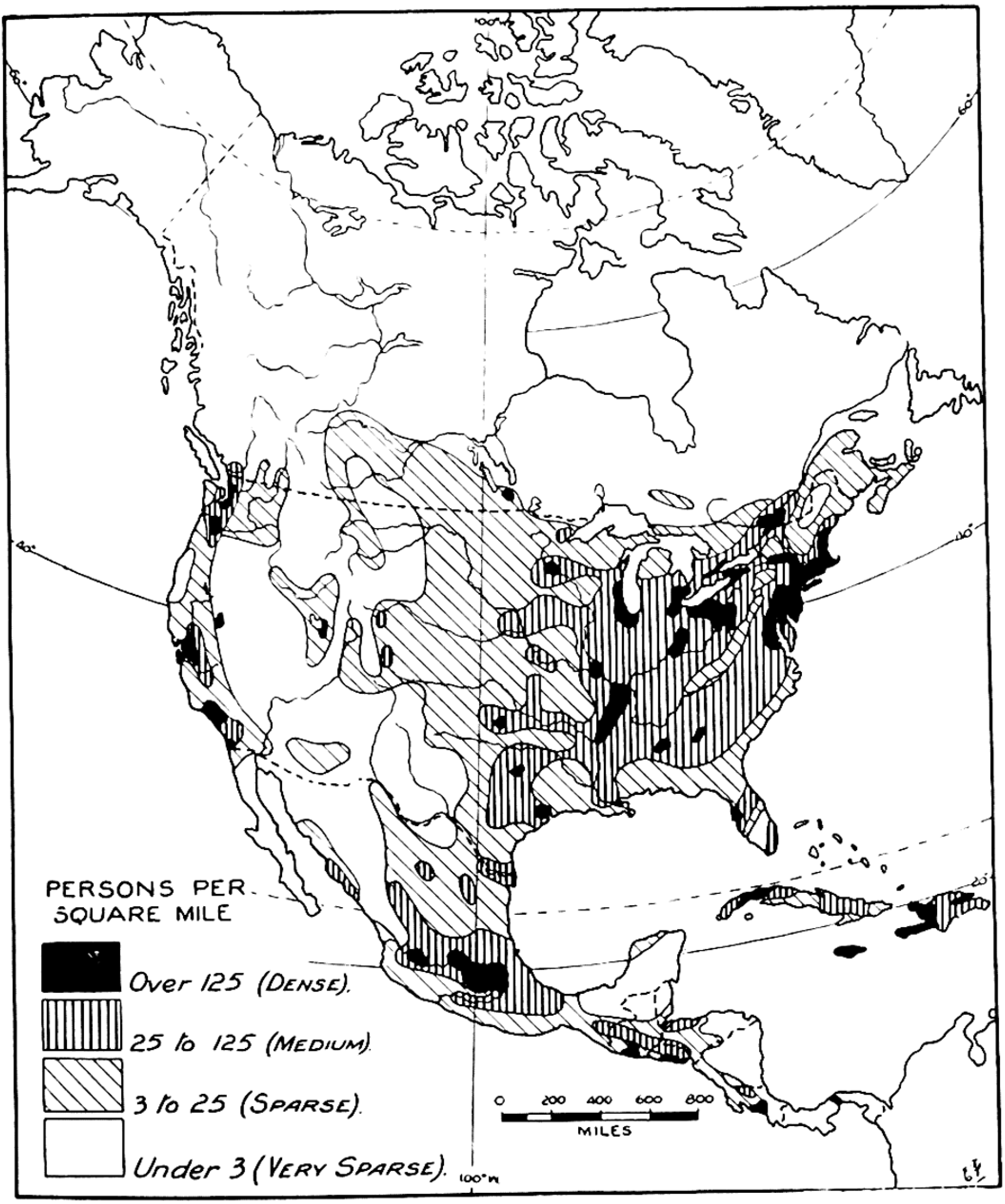


FIG. 96. *Density distribution of population in North America.*

tion. Here the environmental conditions are repellent to human settlement because they are too cold, as in north Canada and Alaska; too rugged, as in the Rockies; too dry, as in the intermontane basins and plateaux; or too hot and humid, as in the jungles of Central America. The human occupations throughout these areas consist of mining, trapping, grazing of cattle and sheep and some lumbering. These tend to collect peoples into isolated spots, as with mining or lumbering, or to spread them thinly over wide areas, as with grazing or trapping.

Next, Figure 96 shows that the well-populated lands are in four main areas:

(*a*) the better-watered eastern half of the United States together with the St Lawrence Valley;
(*b*) the valleys of the Pacific Coast of Canada and the United States;
(*c*) central and southern Mexico;
(*d*) patches in Central America and the West Indies.

These areas are generally most favourable to settlement and development by European peoples in the middle latitudes and by Negro peoples in the tropical lands. Furthermore, as we noted in the chapter on industry, the eastern half of the United States and the St Lawrence Valley in Canada had the necessary resources of coal and iron to allow the development of a great industrial empire.

The development of industry and its handmaidens, commerce and trade, has resulted in the growth of many cities. Urbanisation is a characteristic feature of the north-east quadrant of the United States, where over 80 per cent of the 90 million people living in this area and in eastern Canada live in towns and cities. Figure 97 shows the distribution of the

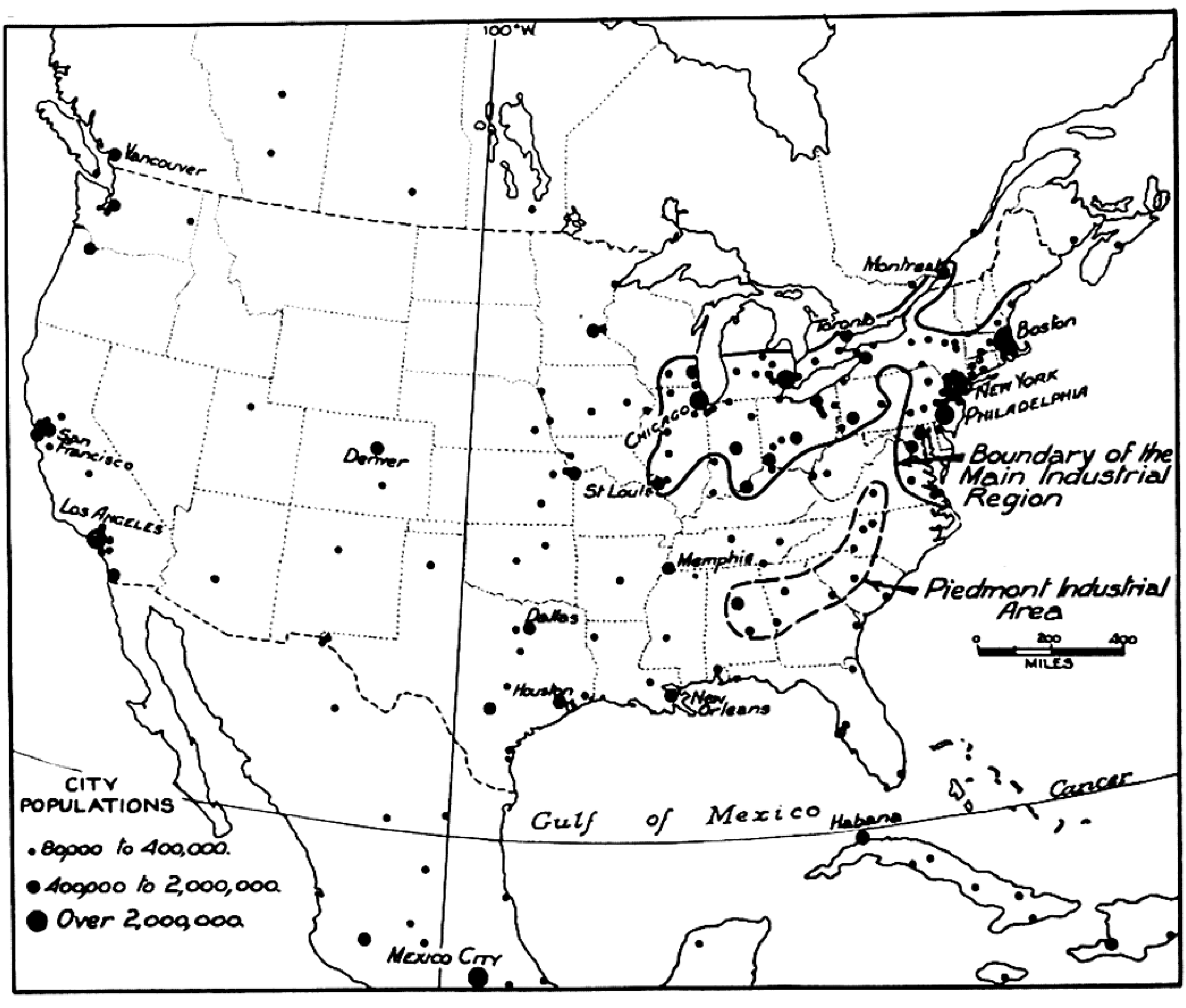


FIG. 97. *Distribution of medium-sized and large cities in North America.*

larger urban centres in North America and the crowding in the north-east quarter is at once apparent on it.

The Pacific Coast, as noted under the heading of industries, has shown a rapid population increase during the past two decades. The population here has grown from 8.3 millions in 1930 to 15.6 millions in 1955 with the most spectacular increase in California, where the respective totals were 5.7 millions and 11.5 millions, an increase of just over 100 per cent in 25 years. Most of this increase has been in the cities, where new industries based on hydro-electric power have attracted tens of thousands of workers. Extension of irrigation in the Valley of California resulting from the development of the Sacramento River scheme and the transfer of its waters to the drier San Joaquin Valley, has helped to bring about considerable increases also in farming populations since 1930.

Canada has three main groupings of population. First the majority of the people live along the St Lawrence Valley and in the Lakes Peninsula. This was the first area settled, and conditions here are favourable for agricultural and industrial development.

Secondly, there is the spread of agricultural people throughout the western prairies and high plains. Here is an essentially farming population with numerous moderate-sized urban trading centres; and a small industrial group of workers concerned mainly with oil and mining for coal and minerals.

Thirdly, there is a small agglomeration of farming and trading settlements in the vicinity of Vancouver along the lower Fraser River.

Most of Mexico's 28 million people live on the wetter portions of the central plateau with Mexico City (population over two million) as the hub. This fertile area supports a densely settled agricultural population. There are also extensive irrigation areas in the north central deserts and on the north-west coast, with moderately dense populations.

Central America and the West Indies have quite high densities of agricultural peoples. In part these are found on plantations, but most are either subsistence farmers or small-scale commercial farmers. There are not many large cities in this area, though modern commerce and industry have resulted in several fairly large ones appearing in Mexico and Cuba.

**2. The Peopling of North America.** At various times in its long history North America was invaded, exploited and settled by many different types of people. Each of these has contributed something to the present culture of its inhabitants and has left its mark on the way of life found throughout the continent.

The first settlers were the Indians, who moved into the land from Asia by way of Bering Strait and Alaska in a series of waves at intervals over some thousands of years. These invasions apparently ceased a long time ago, as all evidence points to the American Indian having developed a separate culture for at least the last 5000 years. Being mainly hunting

and fishing peoples, the Indians tended to move along the grasslands on the eastern flanks of the Rockies. Here the bison, numerous small game the bird life of the swamps, and the fish in the streams gave them food as well as skins for clothing and tents, while the nearby mountain forests afforded wood for their fires and shelter from the winter storms.

Various groups of these people branched off from the main stream and moved to other areas throughout the United States and Mexico as shown in Figure 98. Here they settled on the land and eventually reached widely differing levels of culture and civilisation. On the Great Plains they remained a hunting and fishing people; but in the better-watered eastern forests they developed simple farming based on corn and tobacco. They then became a settled agricultural people besides carrying on the traditional hunting. The tribes here were larger and better organised than on the Plains. At times they were united into strong confederations as were the Five Nations in the Mohawk Valley about the time of the War of American Independence.

In Mexico the Indian peoples developed two outstanding civilisations, that of the Aztecs on the central plateau round the site of present-day Mexico City and that of the Maya in Yucatan, the isthmus of Tehuantepec and Guatemala. These were highly organised societies with a strong central government and an aristocratic ruling class. Society here was based on a form of agricultural serfdom something like that in Europe during the Middle Ages. Their rulers built great cities with many magnificent buildings and temples, and their civilisation has often been compared to that of ancient Egypt.

Finally, the forested coastal lowlands of Central America and the West Indian islands were inhabited by a humble fishing and hunting people known as the Carib Indians. These were the people seen by Columbus, Vespucci and other early explorers and settlers, and the accounts given of them could hardly have prepared Cortez for the type of civilisation he found when he conquered Aztec Mexico in 1519-21.

The Spaniards followed close on the heels of Columbus, and by the middle of the sixteenth century had conquered and explored all of Central America, Mexico and southern United States. At first they were looking for a new route to India, but once Cortez had conquered the fabulously rich Aztec empire, they became interested in the wealth of the American lands. They now entered the new country with two main aims:

(*a*) to collect its mineral wealth for shipment to Spain;

(*b*) to convert the Indian people to Christianity.

The wealth of gold, silver and precious stones collected by the Aztecs and Mayas was soon removed, and the Spaniards then turned their attention to mining with the assistance of an army of slaves. They were brought from Africa or obtained from the densely settled farming areas and as these areas also offered the best regions for converting the Indian people, we find the Spaniards interested in conquering the large farming

settlements. Where they settled on the land, the Spaniards set up huge grazing empires modelled on the feudal estates of Spain; the labour was performed by a host of peons (or Indian serfs). In the West Indies they grew sugar-cane, tobacco and spices on huge plantations where farming was based on Negro slaves brought from Africa, since the Carib Indians were useless as plantation labourers. The Spanish occupation was therefore principally one of exploitation, and the Spanish settlers never adopted the new land in the same way as the English and French in the north-eastern United States and the St Lawrence Valley. The principal mark left by them was the conversion of the people to Christianity and the

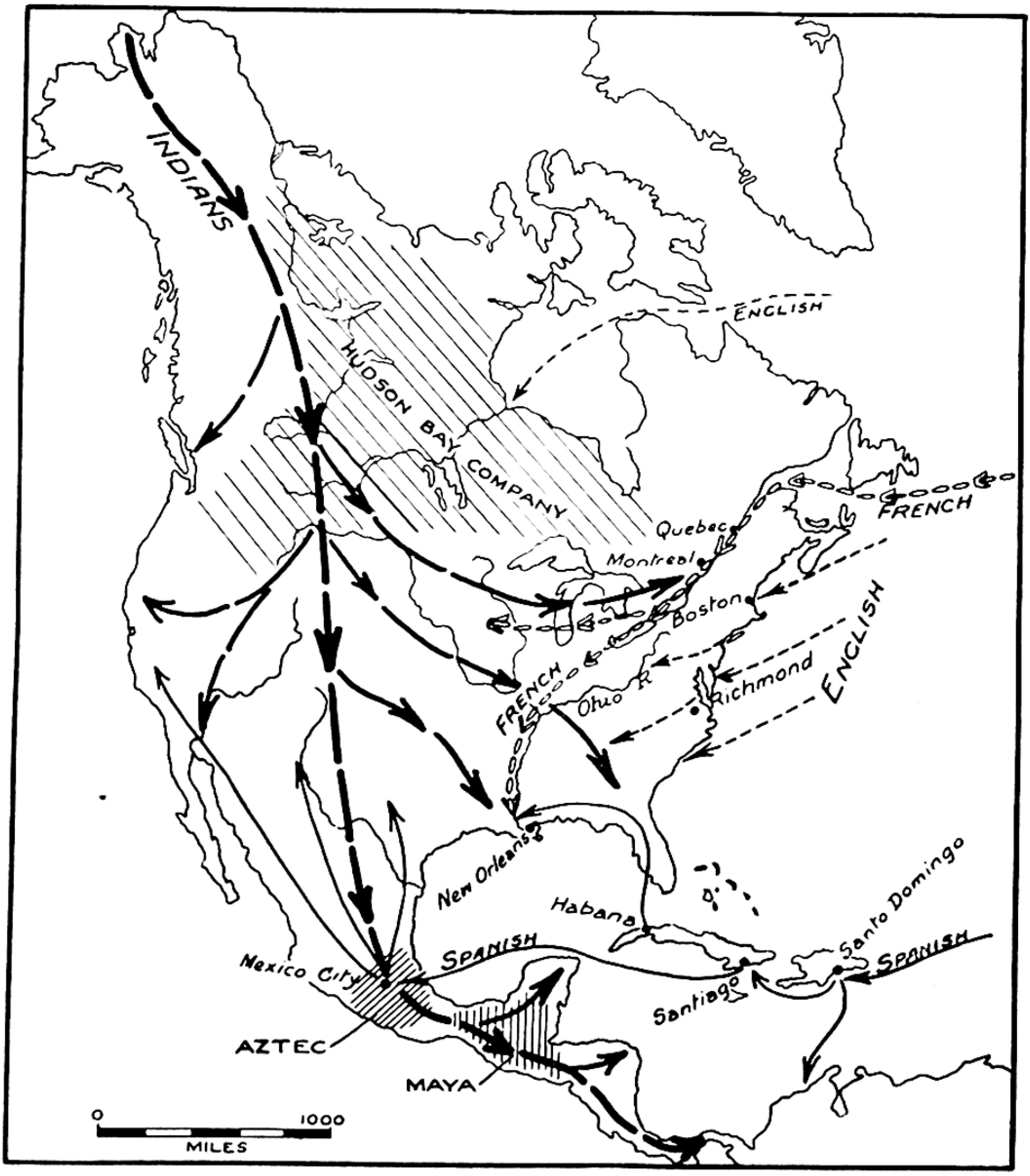


**Fig. 98.** *Diagram map to show the movement of peoples into North America.*

setting up of the hacienda way of living in the grasslands. Their hold weakened and finally collapsed with the coming of the colonising English and French peoples.

The English moved into North America during the sixteenth century when they established tobacco-growing colonies in Virginia, and in the seventeenth century on the heels of the Pilgrim Fathers in the New England area. In the southern settlements their occupation was partly subsistence and partly exploitive; and when cotton was added to tobacco, they found it necessary to import slaves to work on the plantations. Thus was set up the plantation-slave labour economy of the south which was to become the main cause of warfare between the north and south in 1861. In the north the new settlers established a subsistence farming economy with individual ownership of the land by the farmers. Later this area developed trade in fish with Europe and the southern States and also built a strong maritime economy based on whaling and trading. These people fought the Indians for the land and then made it their own. Their settlements, unlike those of the Spanish, had a strong air of permanency. In the southern States however, the landowners were much less attached to the land than the Negro slaves who farmed it for them.

The English also entered North America by way of Hudson Bay, where the Hudson Bay Fur Trading Company was in 1670 granted sole ownership of all land drained by rivers entering Hudson Bay. This gave it control of all the Prairie provinces of Canada as well as of much of the Rockies (see Figure 98). During the next 200 years they gradually opened up this vast area but only on a trading basis. It was not until their stranglehold was broken in 1870 that the great prairie farmlands were opened for agriculture.

The French moved into the St Lawrence Valley about 1550 and set up posts for trading in furs. The first permanent fur-trading settlements were established in 1608 at Quebec. From the St Lawrence French explorers discovered the Great Lakes in the early seventeenth century and then moved into the Ohio Valley and finally down the Mississippi to its mouth in 1682. A French settlement was established at New Orleans in 1717.

The inevitable conflict between the British, settled along the east coast and wishing to expand westward, and the French holding control over the land the English needed, broke out in 1756 in the Seven Years' War. It resulted in the French losing control over all American lands except Louisiana, which was eventually sold to the United States in 1803. French influence still lingers strongly in Quebec Province, where half the present population speak French and follow a French way of life.

At the present time the main features noticeable after 400 years of European penetration and conquest are:

(*a*) British and western European peoples are the dominant type throughout Canada and the United States. They are also by far the most numerous people in North America.

(*b*) Middle America (Mexico, Central America and the West Indies) has mixed racial types with Indian and Negro and mixtures of these as the main peoples. The Indian is dominant in Mexico and Central America and the Negro throughout the West Indies.

(*c*) There is a large group of Negro and Negro half-caste and quarter-caste people in the old cotton lands of the United States.

During the present century large numbers of Negro peoples have moved northwards to the industrial cities in the north-east industrial area and westwards to California. The assimilation of the Negro population into the life of the United States has been accompanied by much ill-feeling and violence. The general cultural relationship of white and black peoples here is still far from satisfactory and forms one of the dilemmas of modern American society.

## EXERCISES

1. **Vocabulary words and phrases:** vertical integration, urbanisation, peon, agglomeration.

2. Using Figures 30, 34, 49, or 50 as a guide, make map-summaries of the following sub-regions of North America:—
   (a) The Canadian prairies.
   (b) The Mid-west of the United States.
   (c) The Mexican Plateau.
   (d) The Gulf Plains of the United States.
   (e) The arid south-west.
   (f) The Basin and Range area of the United States.
   (g) The Pacific Coast of the United States.
   (h) South-east United States.
   (i) The St Lawrence Valley.

3. Draw a map of North America to show the main geographical natural regions. Account for the positions of your boundary lines.

4. Write a general survey (of about three pages) explaining the differences in density shown on the population distribution map of North America.

5. Show how situation and other geographical conditions have helped the growth of Montreal, Chicago, New York, Los Angeles, St Louis and Houston.

6. Describe the position of the Lakes Peninsula of Canada and explain why it is one of the most densely populated areas in the Dominion.

7. Explain the general grouping of Canadian population into three areas, viz., eastern, central and western. Comment on the differences in density in each.

8. Examine the factors that lead to the growth of very large seaports.

9. Compare carefully the distribution of population in the Mississippi-Ohio valleys with that of the Pampas of Argentina. Explain any differences noted.

# CHAPTER XXXI

# MIDDLE AMERICA

## Mexico, Central America and the West Indies

This sub-region, where North America tapers to a narrow isthmus 40 miles wide and issues in a series of islands, is the only tropical portion of the continent. Its very irregular land area totals over one million square miles and is mostly mountainous or upland country.

**1. Landforms.** For the purposes of description it may conveniently be divided into three major sub-regions:

(*a*) Mexico, north of the Isthmus of Tehuantepec;
(*b*) Central America, south of this isthmus; and
(*c*) the West Indian Islands.

(*a*) *The Mexican area* north of the Tehuantepec Isthmus consists of a triangular plateau with high flanking ranges, the Western Sierra Madre (rising to 9000 feet) and the Eastern Sierra Madre (rising to 6000 feet) (see Figure 99(a)). The enclosed plateau consists of two distinct portions separated by a series of irregular mountains. In the south are the intermontane basins in which most of the Mexican people live. To the north lies the huge mountain and bolson region, where the whole land is in the final stages of desert erosion. Here the sandy bolson floors are broken by a series of salty playa swamps that are the final graveyard of the many streams running into the area from the surrounding high mountains. This is a harsh land, where sparse grazing of hardy beef cattle and wool sheep is carried on. Its grimness is relieved by several significant irrigation settlements based on a proper utilisation of the mountain streams.

On the west the mountain and plateau area is flanked by a narrow lowland which passes into the long narrow Gulf of California, itself a continuation of the Valley of California and the southern Californian depression. Beyond this lies the arid and rugged peninsula of southern California (Baja California, the Mexicans call it) which is the southward continuation of the Coast Ranges of California.

On the east, the Gulf Plains of the United States continue along the foot of the Eastern Sierra Madre as a gradually narrowing sandy, lagoon-fringed, malaria-ridden coastal lowland.

Along the southern edge of the plateau there is a chain of lofty volcanoes, which are mostly extinct and which form the highest peaks in Mexico. From them have come the ash and lava which have weathered

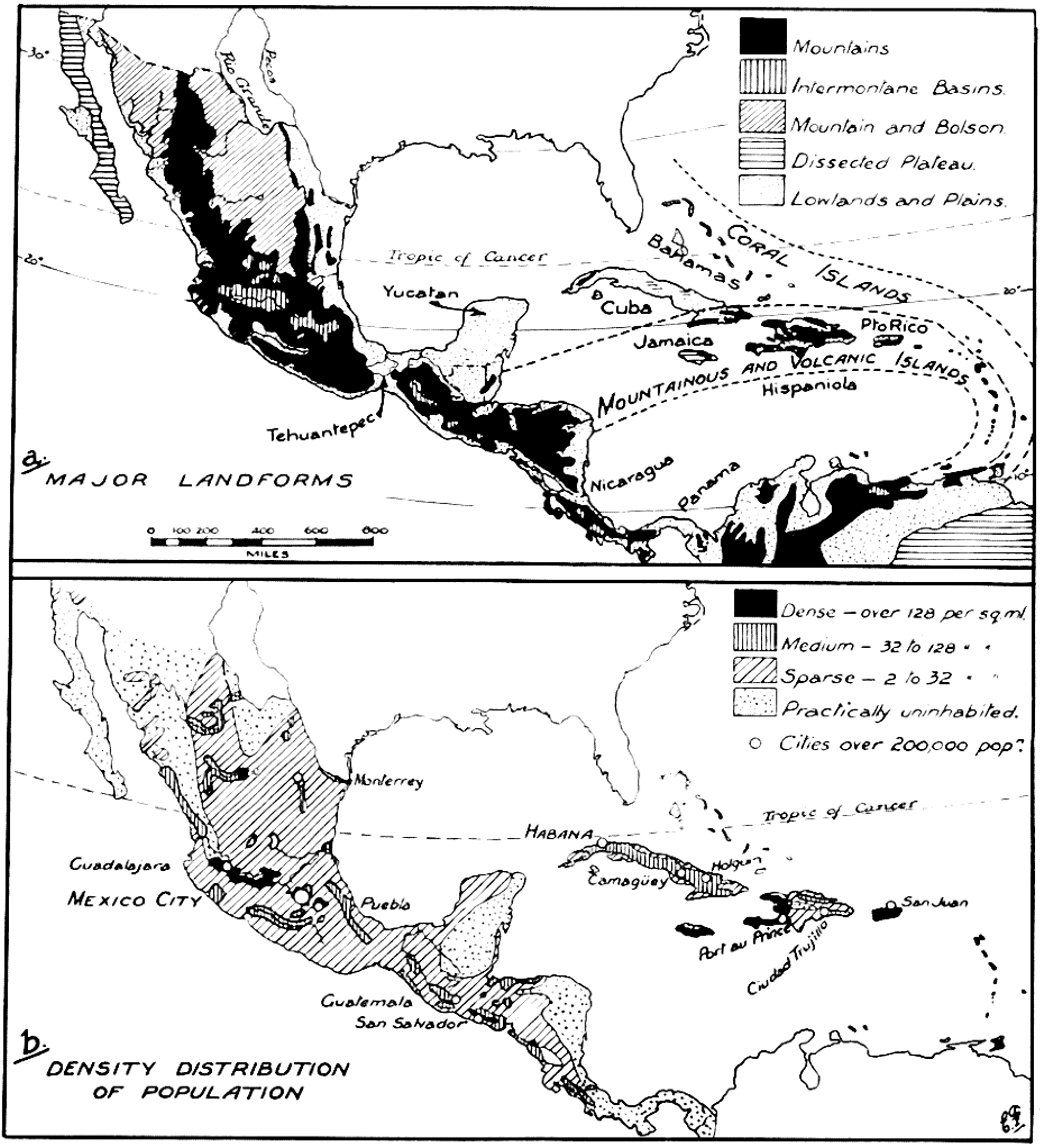


FIG. 99. (*a*) *Landforms of Middle America;* (*b*) *Density distribution of population in Middle America.*

into the fertile soils of the densely settled intermontane basins. The most famous of these volcanic peaks are Orizaba (18,700 feet), Popocatepetl ("Smoking Mountain", an active volcano 17,880 feet high), Ixtaccihuatl (the twin companion of Popocatepetl, 16,880 feet) and Colima (active and 13,000 feet high).

(*b*) *The Central American region* stretches southward of the Isthmus of Tehuantepec to the narrow Isthmus of Panama. It is a rugged and mountainous land except for a broad limestone lowland in Yucatan, a low swampy plain in Honduras and eastern Nicaragua and an important

east-west depression in southern Nicaragua. Most of the higher peaks are old volcanic cones which rise steeply close to the Pacific Coast. Volcanic ash and soils weathered from the lava flows form fertile plains among the mountains and along the coasts, where they are mingled with alluvium from the rivers. There are several active volcanoes and these and the frequent earthquakes are an indication of recent crustal movements.

(*c*) *The West Indian Islands* may be divided into two broad groups; (*i*) the mountainous and volcanic islands; and (*ii*) the low-lying coral reefs and islands (see Figure 99(a)). The mountainous section is a huge arc which continues the general line of the eastern Andes through Venezuela and sweeps round to join the Central American uplands. There are several folds in the Hispaniola-Cuba-Jamaica portion and these are separated by deep troughs which form a trench over 20,000 feet deep between Jamaica and Cuba. A second trench running north of Hispaniola drops to 28,680 feet and is the deepest part of the Atlantic Ocean. At this point (68° 30′ W., 19° 30′ N.) the difference in elevation between the ocean floor and the adjoining uplands on Hispaniola is 31,000 feet, while in the case of Jamaica and Cuba the similar difference is 30,500 feet. These are really great folds.

Most of Cuba and all of the Bahama Islands to the north of it are composed of coralline limestone. Here the crests of the folds reach to just below sea-level and are capped by coral reefs. Only in western Cuba, where the Sierra de los Organos rises to 2000 feet, is the low undulating landscape broken by a rugged upland.

**2. Climate.** All of this region, except the north-western portion of Mexico, lies in the north-east trade wind belt. This means that the northern and eastern side of the islands and of Central America is generally wetter than the western and southern side. The summer is the rainy season; the annual totals are abundant except in northern Mexico, where desert conditions prevail (see Figures 76, 77, 78). Hurricanes often do great damage in the late summer period, particularly along the Gulf Coast of Mexico and eastwards towards Cuba and the Bahamas.

The temperatures on the lowlands and the lower slopes of uplands are constantly hot, but the higher lands have mild temperature conditions. The changes in temperature throughout the highland areas are so noticeable that the early Spanish settlers named them as special zones, and these names have been adopted generally by geographers for describing similar zonations elsewhere in the tropics. These zones are:

(*i*) The *Tierra Caliente*, from sea-level to 3000 feet: hot, wet and forested and generally shunned because of its diseases.

(*ii*) The *Tierra Templada*, from 3000 to 6000 feet, with a generally greater rainfall, but with temperatures averaging from 10° to 20° lower than the Caliente. Here forests of oaks, magnolia, myrtle and bamboo flourish, and crops of maize, coffee, cotton and tobacco may be grown.

(*iii*) The *Tierra Fria*, above 6000 feet and up to the mountain grasslands at about 10,000 feet. This zone includes most of the Mexican Plateau, where the climate is mild and cool, and forests of conifers grow on the wetter areas. Much of the Fria zone has only sufficient rainfall to grow the typical xerophytic shrubs and grasses of semi-arid lands. Crops of maize, wheat, potatoes, beans and temperate fruits are grown on the wetter parts while grazing is the major occupation in the drier areas.

**3. Land utilisation.** Reference to Figure 100 will show that most of the drier parts of the Middle American region are used for grazing, while the wetter parts are occupied mainly by subsistence farming peoples. The other important activities are the result of economic exploitation of parts of the area by American and European peoples for plantation crops and for minerals.

The following general features may be noted about each of the main sub-regions:

(*a*) *Mexico north of Tehuantepec Isthmus.*

(*i*) *Northern Mexico* is an area of sparsely scattered cattle grazing and small Indian subsistence farming communities. Along the western foothills of the Western Sierra Madre are numerous irrigation projects (see Figure 100) very similar to those noted in Peru (Figure 49) on which are grown commercial crops of cotton and wheat (as a rotation crop); vegetables and fruit and sugar-cane. As in Peru, several of these irrigated areas are settled by native subsistence farmers who grow the traditional maize, beans and chile on their small plots. Despite its barrenness northern Mexico is the principal mining area of Middle America. In Coahuila province near Monterrey are useful deposits of bituminous coal and iron ore. These have been used to set up the steelworks at Monterrey. Sonora and Chihuahua provinces have long been important for the production of silver, lead and zinc and, to a lesser extent, copper and gold. The Hidalgo, Chihuahua, Aquiles and Serdan silver mines have made Mexico the leading world producer for the past 400 years and made the Mexican dollar the world's currency during the eighteenth century.

(*ii*) *Central Mexico* is a land of settled mountain basins and river valleys and wild and nearly uninhabited mountain ranges. Most of the people here are subsistence farmers descended from the ancient Aztec Indians. They grow maize, wheat, beans, alfalfa, and chile, with fruits and potatoes as secondary crops. On the east coast, round Vera Cruz, sugar-cane is grown commercially on large plantations, and there are important coffee plantations on the foothills and middle slopes of the Eastern Sierra Madre overlooking the coastal plain. On the west, in the valleys of the Balsas and Santiago rivers, are large areas of irrigated sugar-cane. Elsewhere throughout the area primitive subsistence farming, often with shifting cultivation, is still practised, while scattered grazing is carried on in the drier parts and on the high mountain grasslands

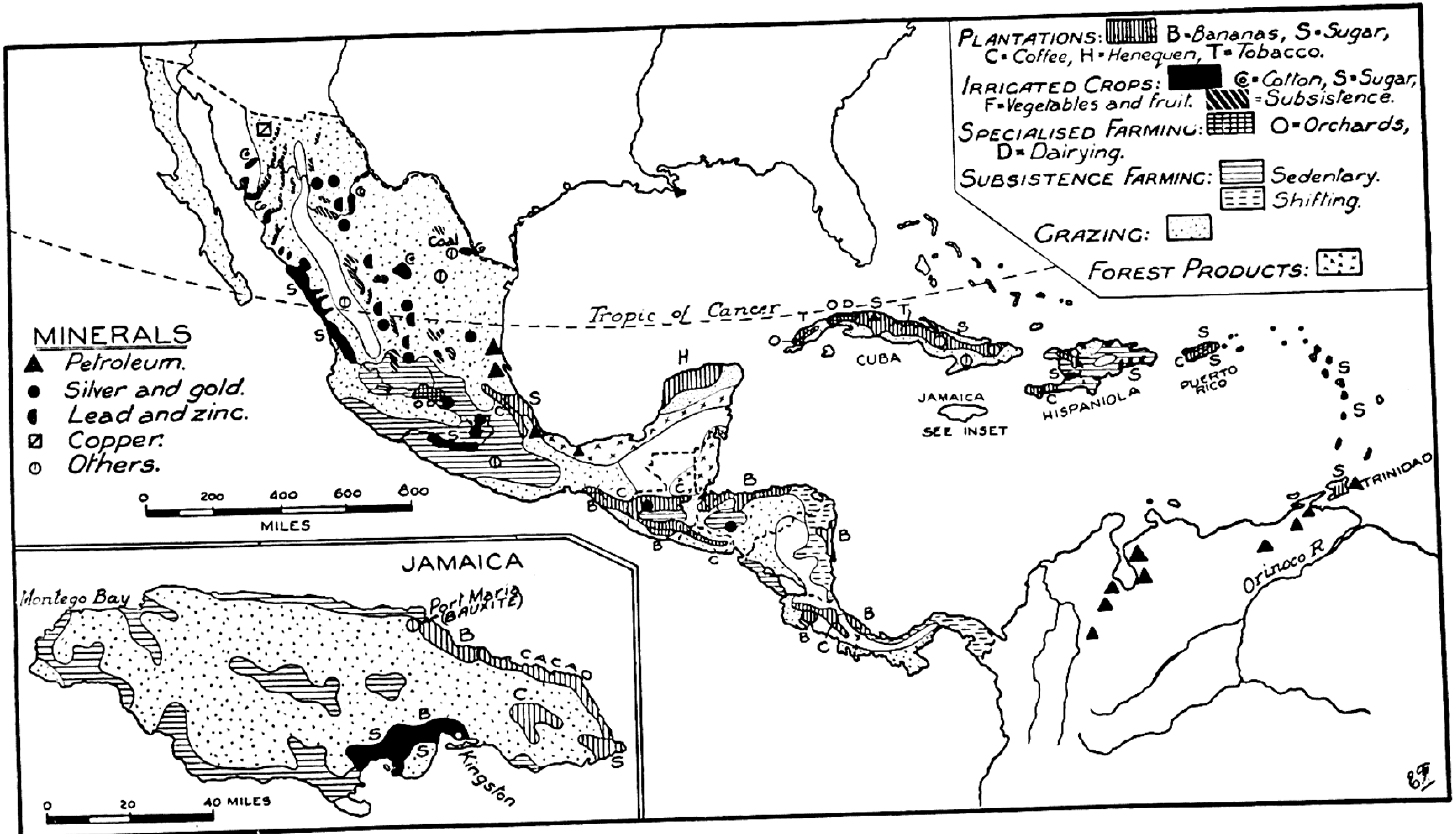


FIG. 100. *Land use and mining in Middle America. Inset of Jamaica on a larger scale.*

(as in Peru, Figure 41). Minerals are not particularly important in the uplands, but there is some mining there for gold and silver; and on the Gulf Coast plain is the Mexican oilfield, which has been developed round Tampico and Vera Cruz. Production of petroleum declined during the period from 1925 to 1948 to a minimum of four million tons in the latter year. It has recently revived and the fields now produce between 10 and 12 million tons yearly.

(*b*) *Central America.*

(*i*) *Mexican section.* Firstly, Yucatan Peninsula is a rather barren limestone region, where large quantities of henequen are grown along the north-western coastlands. Secondly, the isthmus area is a region of forest products from the lowlands, with subsistence farming in clearings. The uplands in this area are the most important cattle-grazing area in Mexico.

(*ii*) *The Central American States* are largely covered with forested highlands which are mostly uninhabited or occupied by shifting cultivators and small groups of sedentary subsistence farmers. On the coastal plains of the east and the mountain slopes of the west are many plantations producing bananas, coffee, sugar-cane and cotton (see Figure 99). Cattle grazing is carried on on haciendas in the higher grasslands of the mountain area and in the drier lowlands of south-western Panama.

The Panama Canal (in the United States-controlled Zone of Panama) forms a link between the Atlantic and the Pacific and is one of the major canal waterways of the world.

(*c*) *The West Indies.* Land utilisation throughout these islands is essentially of three types:

(*i*) Native subsistence farming, with a variety of food crops grown by simple farming methods on small plots of ground.

(*ii*) Huge plantations producing crops for export to the temperate lands of North America and western Europe. Originally founded on slave labour, these plantations now employ a large permanent labour force with extra hands at planting or harvesting time.

(*iii*) The small-scale native commercial farmer. This is a fairly new form of land use and has developed partly through native farmers wishing to earn some money income and partly because in some of the islands (e.g., Puerto Rico) the Government is steadily purchasing large estates and subdividing them in order to establish a strong farming section in the community.

The major crops of the subsistence farmers are root crops, maize, rice and fruits. These are grown on plots varying in size from a fraction of an acre to a few acres.

Plantations are scattered throughout the whole region, and something of their extent in individual islands may be gauged by studying the maps of Cuba and Puerto Rico in Figure 101. Most of the Cuban sugar-cane and much of the fruit and tobacco of both islands are grown on planta-

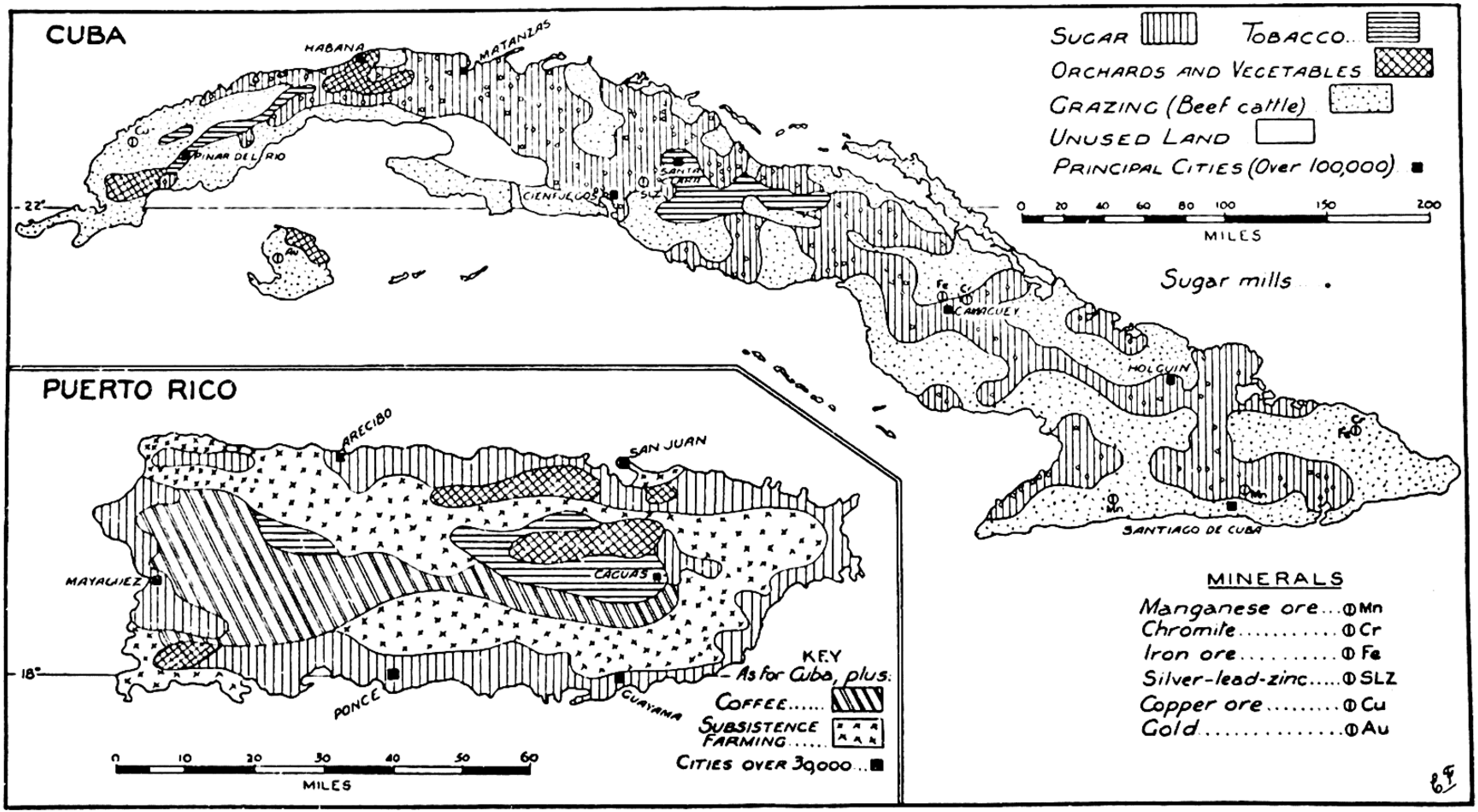


FIG. 101. *Land use in Cuba and Puerto Rico.*

tions owned by foreign capital. The main plantation crop throughout the West Indian Islands is sugar-cane followed by tobacco, tropical fruits, coffee, and cacao. There is also some cattle raising on haciendas.

The independent native farmer today produces noticeable proportions of most commercial crops. The production of sugar in Puerto Rico, bananas in Jamaica, sugar and tobacco in Cuba and vegetables and fruit in most islands is now mainly in the hands of the small farmer.

(*d*) *Cuban sugar industry* (Figure 101). The Cuban sugar industry affords an interesting study of some of the problems associated with the large-scale production of a tropical crop for sale on the world markets.

Cuba is the world's largest producer and exporter of sugar and its production is the principal national occupation. More than 50 per cent of the cultivated land is growing sugar-cane and in favourable years two-thirds of the agricultural income comes from sugar; and sugar and its products yield nearly 90 per cent of the export income. Nearly one-third of the paid working population finds direct employment in the industry at the height of the cutting and crushing period, though half of these return to squalid tenements on the outskirts of the cities once the cutting season is ended.

It was essentially an industry of huge plantations until 1902, when the first of the large modern mills was built. The earlier plantations each processed its cane in a small local mill. With the change in structure in the industry since 1902 many of these smaller mills have disappeared. Less than one-third of the 161 mills in operation in 1954 (see Figure 101) produced two-thirds of the raw sugar.

Since the development of the larger modern mills (or *centrales*) the operations of cane growing and cane processing have tended to become separated. About 90 per cent of the cane is now grown by independent farmers (*colonos*) under contract for sale and delivery to mills near by. The balance of the crop is grown by the mills on their own land with hired labour. The mills also own much of the land worked by the colonos. The majority of these, however, own and work their land with the assistance of hired labour at cutting time. Among the richer colonos mechanisation is slowly replacing the ox for cultivation and planting, and trucks and tractors are being used in increasing numbers to cart the sugar from the fields to the light railroads or to the mills direct. Since the bulk of the crop is sold overseas, the general welfare of most Cuban farmers and the basic structure of Cuban economy are tied closely to the vagaries of world markets. The decision of a buyer of Cuban sugar to grow sugar-beet can have serious repercussions in the island. There has been some effort by the Government to encourage greater crop diversification, as Figure 101 shows, but much of Cuban well-being is still too closely related to its main crop for real economic security.

(*e*) *Population distribution* (Figure 99(b)). Reference to the table of population and population densities at the beginning of Chapter XXXI

will show that all Central American countries, other than Nicaragua and Panama, and all West Indian Islands have a medium to high density population. The general pattern follows the agricultural lands, with high densities in those areas where plantation agriculture or small-scale native farming is developed. On grazing land and in rugged country with shifting cultivators, the density is quite low. Areas of sedentary subsistence farming, as in the Mexican central plateau round Mexico City or in Puerto Rico, can also have very high densities of population. Puerto Rico, for example, with an average density of over 650 per square mile, ranks among the most densely settled lands in the world.

## EXERCISES

1. Compare and contrast the Argentina and South Africa.

2. Draw a map of South America and on it show and name the chief countries. Show on another map of South America the chief agricultural regions. With the aid of these two maps, discuss the food supplies of the different countries of South America.

3. What is meant by continentality? Expand your definition by discussing the distribution of landforms and climates over the earth.

4. Compare the general physical features of the eastern and western halves of the North American continent. Show how physical features have influenced the distribution and activities of the people in these two regions.

5. River valleys are important factors in influencing the distribution of population. Discuss this statement in relation to as many *different* examples as you can find in North and South America.

6. Using library references and oil company pamphlets and journals to help you, write an essay on the pattern and significance of the oil industry in the United States.

7. Using examples where possible, discuss the importance of running water as an agent of landform sculpture in humid climates.

8. Contrast the United States of America and South Africa in regard to agricultural activity and production of food supplies.

9. Draw a map of Africa and show on it the chief groups of peoples. On the same map show the partition of Africa among European powers. Discuss the relation between distribution of peoples and the colonial partitions.

10. What limits does climate set to the economic exploitation of Brazil?

11. With the aid of a map of the world showing the necessary features, write an essay on the general relationships between the continents and the oceans. You might begin by considering such things as the relation of the ocean currents to continental shapes; the distribution of mountains and ocean deeps or the position of plains and wide continental shelves.

# CHAPTER XXXII

# GENERAL SUMMARY OF THE THREE CONTINENTS

As was pointed out in the Introduction to this book, it was based on a content and method which it was hoped would lead not only to the learning of specific kinds of geographic knowledge and skills but to a development of basic understandings and the growth of a geographic way of thinking. In this way there would come a realisation of the responsibility of geography in the changing world of today.

In order to know the material and principles and to gain practice in skills related to them, we studied a considerable amount of physical geography of landforms, climates, soils and vegetation, in respect to both the three continents in particular and the world in general. This was meant to provide the environmental setting for man's many types of activities. At the same time we were careful to note that the nature of the land was not the sole cause of differing ways of life, for these are determined in part by the cultural background and technical skills of the people. Such relationships were shown constantly by many examples which stressed the possibilities of comparisons and contrasts. Such variety was seen to special advantage in the studies of types of farming ranging from very primitive subsistence land use to that of the huge, highly organised kind found on the humid Pampa of Argentina and the prairie lands of North America. Allied with all of them were systems of land tenure and problems of conservation, labour supply and the character of the population. Often historical and social factors were found as important determinants in farming practices, e.g., throughout South America, while difficulties of administration, health and economic welfare of native peoples were almost always allied to the land utilisation of the inter-tropics. The past and present problems of Europeans in their contact with local peoples were emphasised particularly in the cases of South America and Africa, although the United States still has its great dilemma of the Negro population.

The many and complex factors making for the localisation of mining and manufacturing regions were examined at some length to bring out the tremendous developments of North America in those fields. At the same time we observed the potential of the other two continents as sources of various important raw materials for modern commerce. These are being used increasingly in local secondary industries, but large amounts are still exported to sustain dwindling resources in North America

and Europe, especially in the case of petroleum and metals. Such activities in turn have led to significant economic, social and political repercussions, e.g., the attitude towards foreign investments, growing urbanisation and the status and welfare of native populations, as seen in east west and southern Africa, the West Indies, Brazil and Venezuela.

As a result of the increasingly intensive character of agricultural, timber and mineral exploitation these and other great natural resources of the world have been seriously depleted. We saw that this caused such alarm in most countries that ambitious national schemes of conservation were planned but not always carried out fully for many difficult reasons. Anticipating this and realising that certain resources could not be reclaimed or replaced immediately, modern science has sought solutions by stimulating production in small areas or by finding valuable substitutes in hitherto neglected resources, e.g., the use of trace elements in agriculture and the replacing of metals with plastics. But since the world's foodstuffs are of such great importance, some time was given to the study of the remarkable advances in irrigation, especially in the United States. We saw, too, that science has done much to affect geography by its control of diseases dangerous to man, crops and animals. This was mainly evident in our studies of the opening up of the tropical lands, e.g., West Africa.

Geographic factors relative to trade and transport were examined at frequent intervals in the work and led to our fuller appreciation of the reasons for prosperity and/or poverty in various countries. Very obvious contrasts were seen between the highly organised transport, great wealth and high standard of living throughout almost all North America, and the very limited communication patterns, poverty and illiteracy of much of South America. Such studies always led us to further considerations of the siting and functions of towns and cities as centres of government, service, manufactures and markets. Of special interest were the sparse marginal distributions of these in Africa and South America as against the great number of inland settlements of North America. In the former two continents ports assume importance because of their links with difficult but valuable hinterlands.

The character and spread of populations were always linked with the many factors outlined above, and we were careful to note how settlement really reflected the geographic circumstances of each region under review. Historical factors were evident in South America, whilst in other cases physical, economic or transport reasons were responsible for the patterns. Altogether it is one of the more complex problems of geography work and so deserves the special attention given it in the various exercises suggested.

From time to time we had occasion to look at possible future developments of these continents from the point of view of the geographer. Summing up now, we can say that while North America has reached a

high stage of technological and social development, it is using these achievements to push on towards the opening up of lands hitherto avoided, e.g., the Arctic and the marginal lands of the deserts. Already there have been spectacular developments within these areas. The search for and exploitation of much-needed minerals is being pushed on, e.g., the iron ores of the Laurentian uplands and the oilfields of the Canadian prairies. But there are also rapid changes in the pattern of life in Africa and South America, although these may be limited to certain well-defined areas because of tremendous physical disabilities in others, e.g., Amazonia. There has been a move in those parts towards self-sufficiency in the ultilisation of many foodstuffs and raw materials which formerly went to other continents. This has been due not only to the needs of growing populations, but to the increasing mechanisation in agriculture and industry associated with the growth in education of native peoples who have become capable of doing skilled jobs. In many cases, though, this has meant a movement away from agricultural homelands to the attractions of trade and industry in cities. One big problem that had to be overcome was lack of coal, but it has been met in part by the use of hydro-electricity. Finally, we have noted that all these and other developments have given rise to greater national consciousness, and demands for self-determination and self-government have led to many significant economic and political changes in recent years.

In this connexion the significance of the concept of Pan-America might be examined briefly. North America's ties with the southern continent are based mainly on economic and strategic reasons. Thus for the former there are several important sources of raw materials and foodstuffs in South America, including tin, iron ore and petroleum, and tropical fruits. Transport is relatively short and cheap and is often closely related to the strategic Panama Canal Zone. Trade with North America has frequently helped to provide wealth for Government services, as we saw in the case of Venezuela. Also much air transport, so vital to South America, is provided by foreign airways. Technical skills have been introduced by North American interests, and in the more difficult environments health and hygiene measures have had beneficial effects. But these and other benefits touch only a small fragment of the southern continent's population. Apart from the economic aspects, the cultural ties of South America are more with Europe, since so much of the population has strong Spanish and Portuguese elements. This background and high standard of education in the upper classes has made possible the limited but distinctive contributions to the arts and sciences to be seen in the magnificence of Rio de Janeiro and the town planning and architecture of cities like Belo Horizonte. At the same time there exists a mentality and attitude towards business and Government which it is difficult for North Americans to understand and yet easy for them to condemn, e.g., the aristocracy of land tenure and the retention of dictatorship. Also it is hard to appreciate the extent of the problems of diet,

hygiene and illiteracy in the bulk of the population. Nevertheless, North America must maintain strong relationships with South America, if only to anticipate the need of urgent raw materials in war together with the strategic position of the continent at the southern "back door" to the United States. Particularly vulnerable points are the regions of Central America (with the Canal) and Brazil (open to invasion from West Africa). A final necessity is that of watching political developments, since hostile republics could well make way for enemy infiltration and the establishment of a dangerous bridgehead.

## EXERCISES

1. Write an essay on the formation, location and development of cities in the Caribbean region.

2. Compare and contrast the general structure of the sugar industry in Cuba with that in Queensland. (*The Rural Scene* will give you details of the Australian sugar industry.)

3. Describe the differing climates and vegetations to be met with on a climatic traverse from Buenos Aires to Montreal. You could do this by taking an imaginary air trip, stopping at key climatic towns en route.

4. Discuss the part played by the Spaniards, French and English in the settlement and economic development of North America.

5. What are the characteristics of the climates found between the tropics? Describe *one* type in detail and show its effect upon human activity.

6. Show how the control of Nile waters has been the secret of Egypt's prosperity in modern times.

7. How far do the political divisions of South America correspond with the main geographical divisions? Can you explain any differences noted?

8. "Modern industrial development involves increasing demand upon the raw materials of the tropics." Discuss this statement.

9. Estimate the importance of shifting cultivation in the native economy of the tropics and discuss the ways in which it hampers economic development.

10. "Brazil, Canada and Australia all suffer from inadequate populations over large parts of their territories." Discuss this statement giving reasons and possible solutions to the problem.

11. Show how the modes of life of any *two* of the following peoples are related to their geographical environment: Eskimo, Masai, Amazonian Indians, Negro peoples of Cuba, Indians of the Peruvian Andes.

12. Analyse the chief characteristics of the traffic on the Great Lakes of North America.

# APPENDIX

# MEMORY MAPPING

## Need for Memory Maps

Memory mapping forms a very important part of your work in tests and examinations. Good, clear sketch maps will improve any answer and are always superior to long essays when you are describing the location of products and other geographical features. In addition, the examiner often sets questions requiring you to draw a map of one of the continents to show certain geographical features such as climate, vegetation, mineral areas or land use regions. Any student can score high marks in such questions because the ability to draw good maps from memory lies within the power of all boys and girls. All that is needed is a desire to learn to draw a map. This means a willingness to give a new method a try and a determination to practise it for some weeks.

Once you really want to learn, the task may be simplified by adopting a system of work and then practising it until you know it thoroughly. The practice should be spaced over a period of days rather than ten or a dozen tries on one day. Learning to draw a map from memory is like learning to play a new piece of music, or sing a new song, or learn a new stroke in tennis or cricket, or a new method of kicking when swimming. All these are new skills and they need time and concentration for days, even weeks, before they become easy to do. They also need further practice from time to time over the year if they are to be remembered fully.

## Materials Required

These are simple and should be in all students' school cases. Any map may be drawn if you have:

1. A ruler, preferably marked in inches and tenths of an inch.

2. An HB-pencil sharpened to a point.

3. A soft rubber.

4. Three or four coloured pencils. Dark colours are best; yellows and pale colours do not show up on white paper. A dark blue, red, green and orange will suffice, though a good black pencil like the Staedtler *Lumograph EXB* will be found very useful.

5. An ordinary pen and some ink. A fountain pen will do quite well here, but Biros are not suitable for mapping.

## What is required in a Memory Map

It is important from the start that you have a clear picture in your mind of the kind of map you are trying to draw. No examiner expects students to draw a map with the same degree of accuracy as would be achieved in a homework exercise taking several hours. At the most you will have 30 minutes to complete the map in the test, so that speed and approximations become necessary. A good examination map should have the following features:

1. A clear, clean outline. Keep the coastline smooth; nothing looks worse than a wriggly coastline that appears to have been drawn by a person with palsy. Show only the larger bays and gulfs on your coastline, e.g., in Australia it would be necessary to include the Gulf of Carpentaria, Cambridge Gulf, King Sound, Shark Bay, the two gulfs in South Australia, Port Phillip and Princess Charlotte Bay.

2. Correct proportions from east to west and north to south. Thus, Australia is five units wide and four units deep. This is one of the main things that makes a map "look right".

3. Correct alignment of places on the map. In Australia Cape York is north of Melbourne and Sydney is almost due east of Cape Leeuwin. This makes the map "sit right" on the page.

4. Reference lines should be included. The best lines to use are parallels of latitude and meridians of longitude. One of each, crossing at right angles in the middle of the map is best.

5. A scale. This may be obtained by knowing the distance between two well known towns or places on the map. In this regard it is easy to remember that one degree of latitude equals 70 miles, or that the distance from the Equator to a tropic is 1640 miles, which for approximate purposes is 1600 miles. The scale is best shown as a line at the bottom of the map and marked off into suitable segments such as you may see on any map in this book.

6. A north-south arrow to give correct orientation to the map. Here you should know that a meridian runs north and south and if you have used a central meridian for a reference line the placing of a north-south arrow should be easy.

7. A good outline will include sufficient rivers and towns to act as a reference frame for putting in regional information. A map without a few cities dotted over it looks naked.

## How to Make and Use a Framework

Several important things are listed here:

1. In the frameworks used in this Appendix a scheme of proportions is adopted rather than measurements of distances in inches and parts of an inch. This allows for the size of the map to be varied easily. You will

understand this much better when you read the notes on each of the three maps (see Figures 103, 104 and 105).

2. Start with two or three *base lines*, which are preferably a central meridian and one or two parallels of latitude. Work outwards from these when adding other lines to the framework. The base lines are drawn very heavily on the maps in this section so that you may pick them out quickly. These lines, and all other framework lines should be drawn *lightly in pencil* so that they may be rubbed out easily when the map is completed.

3. One of the easiest frameworks is made up of a series of squares based on a distance between two easily identified points on the map. This is called the *basic distance* and is marked clearly on Figures 103(b), 104(b) and 105(b).

4. Occasionally lines other than the sides of the squares will aid greatly in getting a good outline, e.g., in North and South America. These should be related to the squares already there and should be few in number.

5. All framework lines should be kept to the barest minimum necessary to get a good outline. A large number of lines is difficult to learn, takes too long to draw and only makes a mess of the page.

6. It is always better to work out you own framework if you can. You will remember it much better than one you have copied, but you may not find it easy to better the ones given here, for they have been evolved after much trial and error.

7. It is possible to work out similar frames for parts of countries such as the north-east corner of the United States or one of the States of Australia.

## Method of Learning the Outline

The following steps will help you to master using frames for map drawing:

1. Select a good outline of the continent. A projection with straight parallels is best (as in Figure 103(a) and 104(a)); but sometimes, as with North America, such a projection results in bad distortion of shape. It is then better to select one with curving parallels, as was done in Figure 105(a). You can use the outlines in Figures 103, 104 and 105 if you wish, as they are sufficiently accurate.

2. Draw the framework on the map selected as has been done in Figures 103(a), 104(a) and 105(a). This good map with its superimposed frame is called the *master copy*. You may use the three maps in this chapter as suitable master copies.

3. Draw a framework on a separate piece of paper, as has been done in Figures 103(b), 104(b) and 105(b). Do this five or six times until you can draw it in *one minute or less.*

4. Now copy the outline on your frame, noting where the coast crosses the sides of the squares and avoiding wriggly lines. The best way to do this is to sketch the basic shape in lightly, correct any obvious errors in it and then go over it more heavily in pencil. Do not ink it in until you are satisfied with it.

5. Put away all the maps and draw a frame and outline from memory as quickly as you can. Check this with the master copy and note any bad errors so that you may correct them next time you try.

6. Once or twice a day for a week draw fresh practice frames and outlines, checking each one against the master copy and correcting any errors. Always work against the clock; it is vital that you attain speed in all your memory mapping. The only way to do this is to note the time you take in each try and then try to beat it in the next attempt.

7. At the end of a week of conscientious practice of this nature you should be drawing a good outline at high speed. In the final attempts you should ink in your maps, as all examination maps are expected to be drawn in ink. You should also add the main rivers and the towns on the later maps. Get the outline satisfactory first, then add the details to it. And do not forget the reference lines, the scale and the north arrow on your final maps.

## Shading and Colouring Maps

Many beautifully drawn outlines are spoiled by poor shading and colouring. It is necessary to practise this as well as outline drawing, and several things can help here:

1. As mentioned earlier, only four or five coloured pencils are needed to colour any map. In fact, as the maps in this book show, it is possible to use one colour only and still get a clear result.

2. Shading lines should be clear and bold and evenly spaced at some distance apart. Figures 102(a) and 102(b) show the difference between

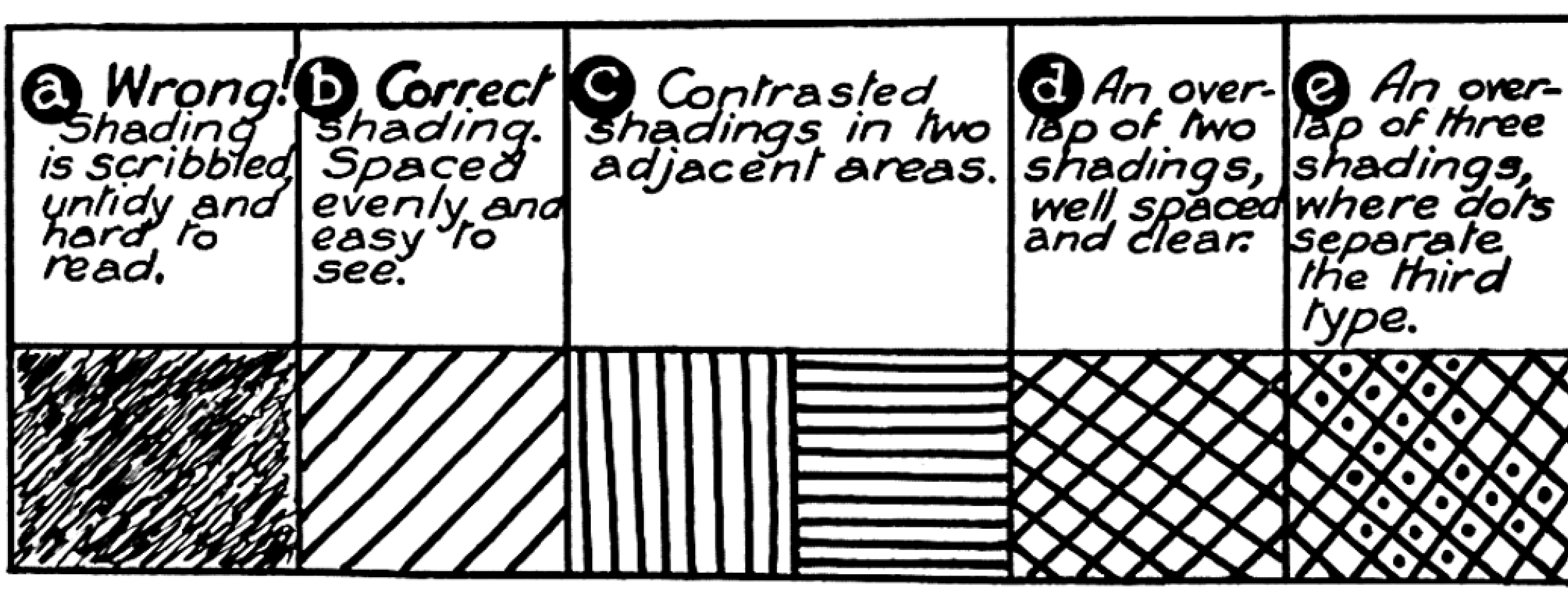


FIG. 102. *Samples of simple shading for use on maps. All of these have been drawn by hand in a few minutes. Note how untidy number 102(a) is when compared with the others.*

scribbly shading (with all its untidiness) and neat, parallel lines on a map. You will have to practise shading by freehand sweeps over areas you mark out on a piece of paper. Artists do this for hours on end to get perfection in their shading lines.

3. Always shade adjacent areas in contrasting colours and as far as possible in different directions. Figure 102(c) shows this clearly. Where several lines of shading are placed in the one area it is still possible to get a clear result by carefully shading in different directions or introducing dots as is done in Figures 102(d) and 102(e).

4. A key is always necessary to explain the meaning of the colours and shading used on the map. In the key the small colour rectangles need to measure at least a half-inch by a quarter-inch. Small dots of colour or little scribbled patches are merely confusing and cannot be read by a person looking at your map.

## Enlargements of Parts of Maps

Portions of any of the maps may be drawn on an enlarged scale by using the appropriate squares and re-drawing them at double or treble the present scale.

Thus the Great Lakes and St Lawrence Valley are contained in two small squares on Figure 105(a). This area could be drawn to full-page size by trebling the size of these squares and drawing in the diagonals in each to aid in reproducing the map on the enlarged scale. Other selected areas may be similarly treated on any of the maps.

Practice of this kind will be found useful when doing regional studies.

## Memory Map of Africa

Figure 103(a) shows the outline with a framework superimposed on it. It also gives an idea of what are the minimum requirements for an outline. You would need to add ten or a dozen well-spaced cities to the map in order to complete it.

**Construction of the frame.** The basic lines used are the 20° E. meridian, the Equator and the Tropic of Cancer.

(*a*) Draw the 20° E. meridian slightly to the right of the centre of the page.

(*b*) Mark in the Equator across the middle of the page.

(*c*) Space in the tropics on each side of the Equator in such a way as to allow for half the space between them and the Equator to be added to the top and bottom of them. Africa extends on each side of the Equator for a distance equal to 1½ times that between the tropics and the Equator.

(*d*) It also extends for an equal distance west of the base line Number 1 and nearly the same distance east of it.

(*e*) All these main lines are heavier on Figure 103 to aid you in finding them.

(*f*) Now mark in the smaller half-squares as has been done with light lines on Figure 103. You will see the need for these when you study them in relation to the coastline and rivers. Thus:

(*i*) The line AB helps to fix the position of the Nile River, Lake Victoria, Lake Nyasa and the east coast of southern Africa.

(*ii*) The line CD fixes the Gulf of Gabes and the turn in the coast at the head of the Gulf of Guinea.

(*iii*) The line EF fixes the position of the Horn of Africa and the Guinea Coast (half-way between it and the Equator).

(*g*) The scale comes from the distance between the Equator and one of the Tropics. Note that the line shows the approximate 1600 miles, not the exact 1640 miles as on the map.

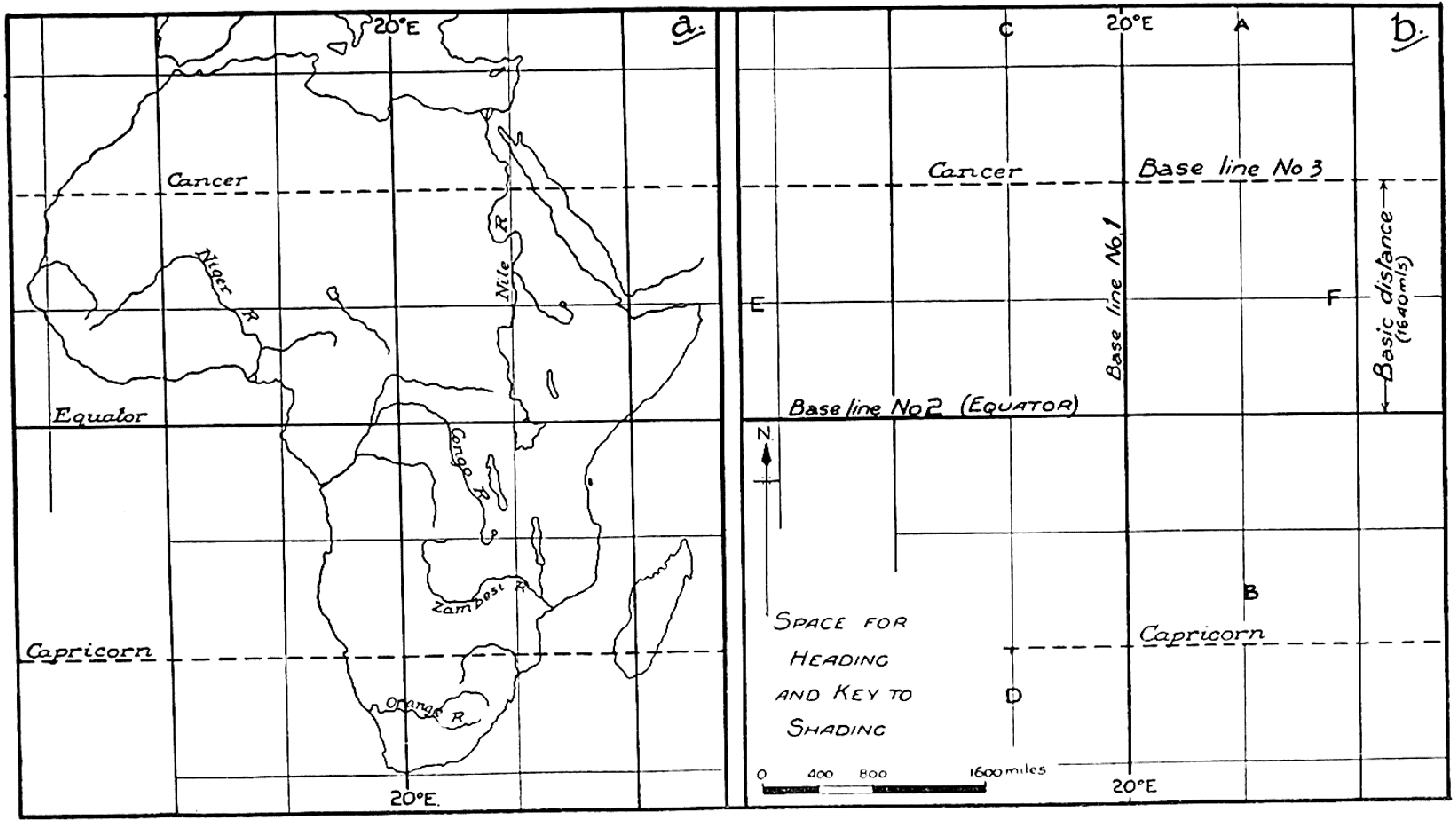


FIG. 103. *Diagram of a scheme for drawing a memory map of Africa.*

## Memory Map of South America

Figure 104(a) shows the suggested frame drawn on the outline of South America. It also shows a sufficient pattern of rivers to which the names need to be added.

(*a*) The base line (see Figure 104(b)) is here the 60° W. meridian and this is drawn in the middle of the page.

(*b*) The Tropic of Capricorn is now drawn across the middle of the page.

(*c*) Draw the Equator in such a position as to leave room for another line north of it at a distance from it equal to half that between the Tropic and the Equator.

(*d*) Mark in a series of small squares with their sides equal to half the distance between the Tropic and the Equator, as has been done on Figure 104(b). These squares will have sides of approximately 800 miles.

(*e*) Draw a line through the points A and B and extend it both ways. Also draw a line through the points C and D. The point C is where the line AB when extended cuts the side of the most easterly square.

(*f*) This is now a suitable frame for South America and, as Figure 104(a) shows, the two lines AB and CD are particularly useful in fixing the north and east coasts.

(*g*) The scale is again obtained by using the distance between the Tropic and the Equator and approximating 1600 miles from it.

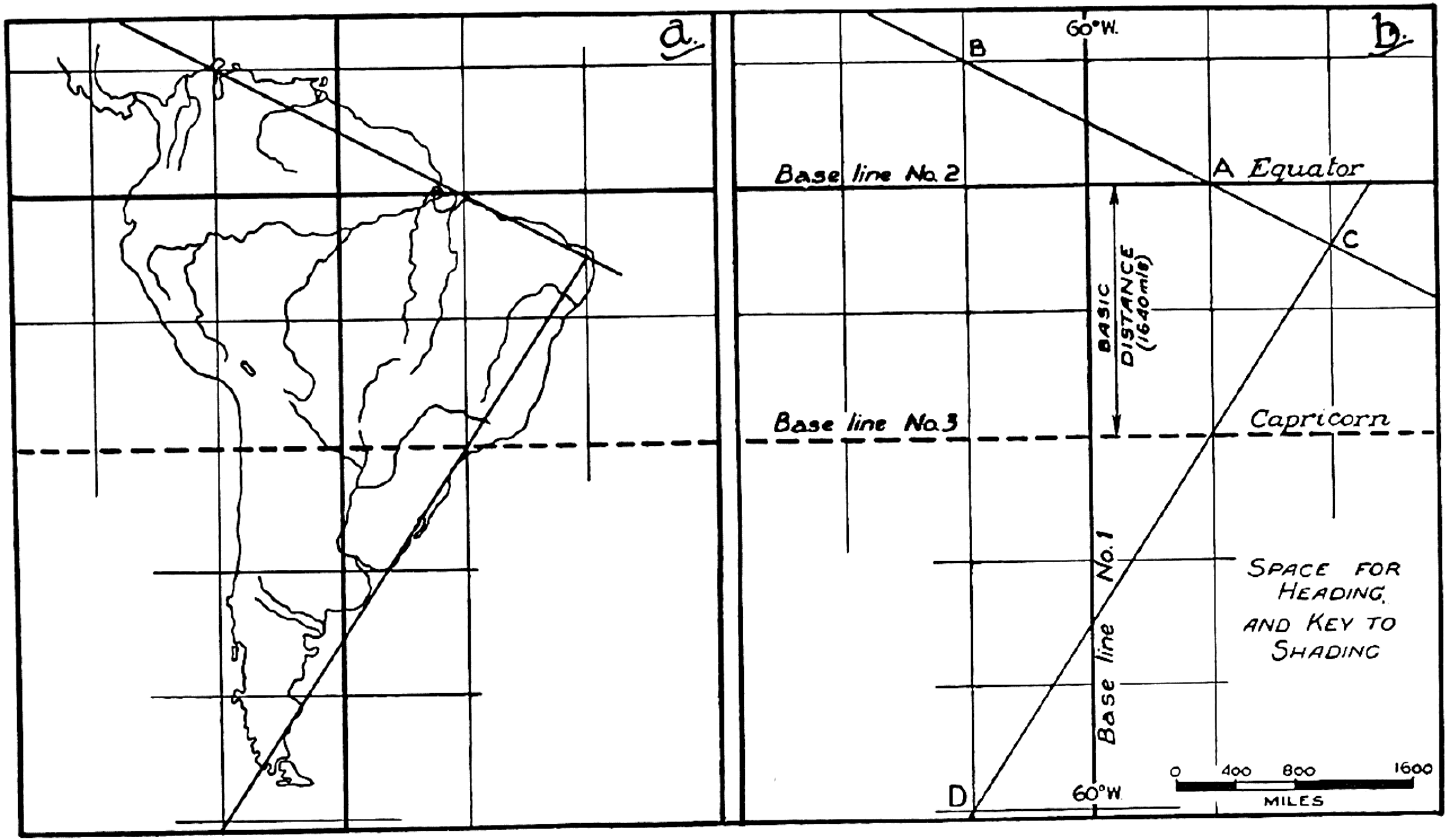


*Fig. 104. Scheme for drawing a memory map of South America.*

## Scheme for Memory Maps of North America

A problem arises because it is not possible to use straight parallels and get a good outline of North America.

(*a*) Draw the 100° W. meridian down the middle of the page. This is not only a base line for the memory map but is also an approximate geographical boundary between grazing on the west and agriculture on the east in the United States. It is a key meridian and that is one reason for choosing it here.

(*b*) Draw a horizontal base line across the page slightly below half-way down. This cuts the 100° W. meridian at a point (P) where it intersects the curving parallel of 40° N. (See Figure 105(a).)

(*c*) Mark off a point half-way between base line Number 2 and the bottom of the page. This gives the position of the point Q, where the Tropic of Cancer cuts the 100° W. meridian. It also gives the base distance of 1150 miles and the length of the sides of our squares.

(*d*) Mark off the whole page into squares with sides equal to the base distance.

(*e*) Join A to B (note carefully which corners of which squares these points are on) and A to C. Note here that AB cuts the 100° W. meridian at R, which is the point where the Arctic Circle cuts it (see Figure 105 (a)).

(*f*) With A as centre and AB as radius draw an arc as shown. This is most valuable for giving correct shape and form to the rather difficult west coast.

(*g*) You may find it advisable to put in extra lines to help in drawing the Great Lakes, which are so important in American geography and so hard to draw. Try a diagonal line or two in the small square containing them.

(*h*) Fixing the north coast of the Gulf of Mexico would be easier if a horizontal half-way line in the small square were drawn in.

(*i*) The scale on this map comes from PQ, which is 1150 miles. This can be reduced in length by one-seventh to make it 1000 miles as on Figure 105(b), or it can be lengthened slightly to make it 1200 miles and then halved and quartered to give 600- and 300-mile lengths.

(*j*) The finished map should have the Tropic of Cancer and the fortieth parallel sketched in and should show ten or a dozen cities scattered over it.

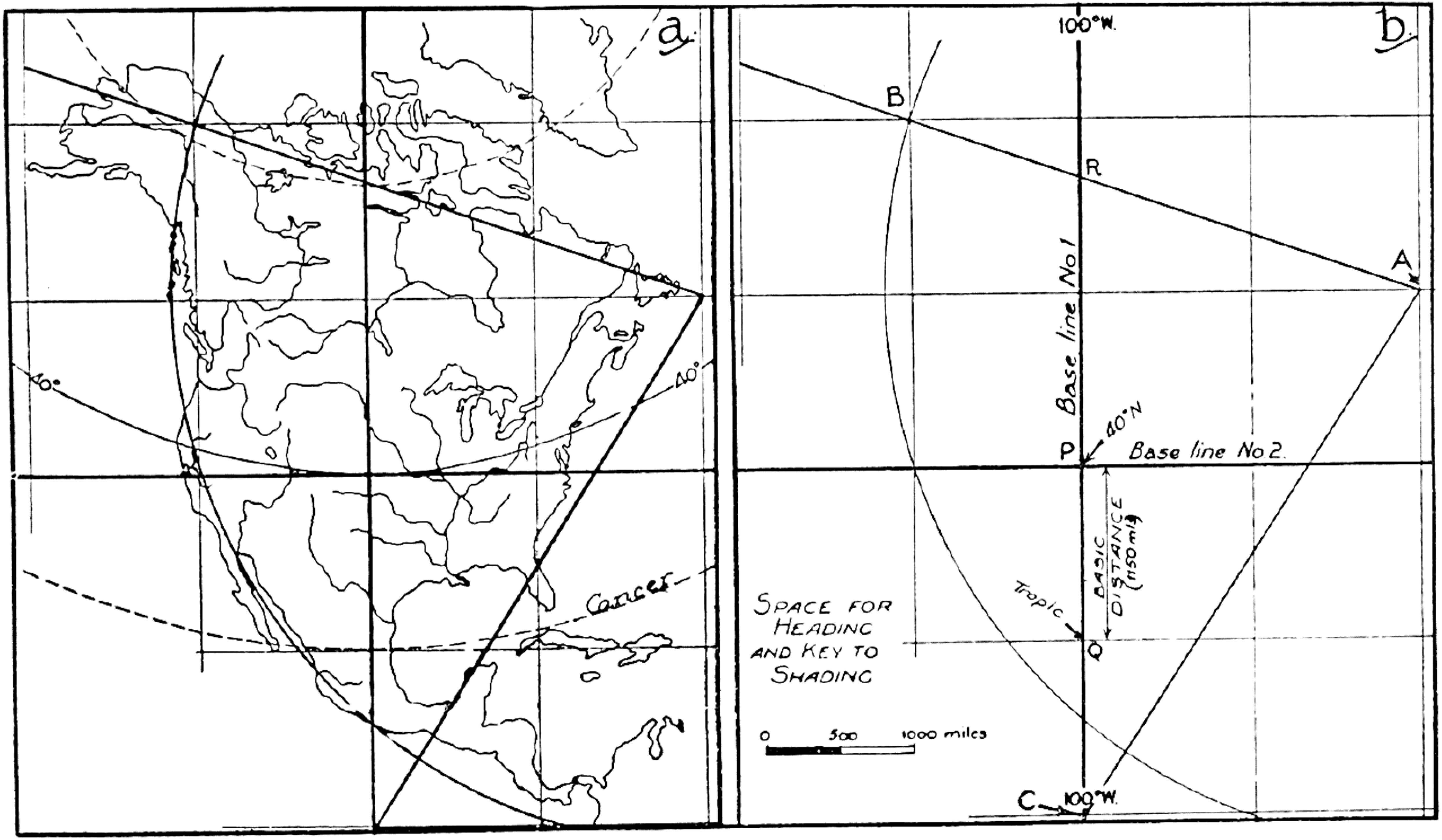


FIG. 105. *Scheme for drawing a memory map of North America.*

# BIBLIOGRAPHY

This is not intended to be either a full bibliography of the books and pamphlets the authors used or a complete geographical bibliography on each of the divisions named in it. It is a guide to useful publications which might form the nucleus of a school library, or which the student might consult to obtain a wider knowledge of his chosen subject. For convenience the list is subdivided into sections, but many of the books deal with some or all of the sections listed; their inclusion here in a certain section indicates the main topic treated in the book.


## 1. Physical Geography

Finch and Trewartha, *The Elements of Geography.*
Freeman and Raup, *The Essentials of Geography.*
Horrocks, *Physical Geography and Climatology.*
Kendall, Glendinning and MacFadden, *Introduction to Geography.*
Kendrew, *Climates of Continents.*
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Peel, *Physical Geography.*
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Stamp, *The Earth's Crust.*

## 2. Economic

Bengston and van Royen, *Fundamentals of Economic Geography.*
MacFarlane, *Economic Geography.*
Rudmose Brown, *Principles of Economic Geography.*
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Whitbeck and Finch, *Economic Geography.*
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Oxford Economic Atlas of the World.

## 3. Regional

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Herdman and Hurworth, *The Southern Continents; The Northern Continents.*
Jones and Bryan, *North America.*
Pickles, *North America; South America.*
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Stamp, *Africa.*

Stamp and Suggate, *Geography for Today, Books Two and Three.*
Whipple and James, *Neighbours on our Earth; At Home on our Earth.*
White and Foscue, *Regional Geography of Anglo-America.*
Whitbeck and Williams, *Economic Geography of South America.*

**4. General**

Carter and Bretnall, *Man the World Over.*
Davis, *Earth and Man.*
Ford and Rowe, *The Rural Scene; Regions and Men.*
Greenwood, Honour and Lockie, *Introducing Geography.*
James, *Geography of Man.*
James and Browne, *The Modern World Geographies.*
Laborde, *The World in Outline.*
Morris, *The Earth: Man's Heritage.*
Stamp, *The World.*
Stembridge, *The World.*
Unstead, *The Regions of the World.*
Thralls, *The World, Its Lands and Peoples.*
Wilmore, *The Groundwork of Modern Geography.*
White and Renner, *Human Geography.*

**5. More difficult texts** which may be used for reference on certain special topics.

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Woolridge and Morgan, *The Physical Basis of Geography.*
Hills, *The Physiography of Victoria.*
de Martonne, *Shorter Physical Geography.*
Miller, *Climatology.*
Fitzgerald, *Africa.*
Forde (Darrell), *Habitat, Economy and Society.*
James, *Latin America.*
Gourou, *The Tropical World.*
Money, *Introduction to Human Geography.*
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Shanahan, *South America.*
Taylor (Ed.), *Geography in the Twentieth Century.*

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